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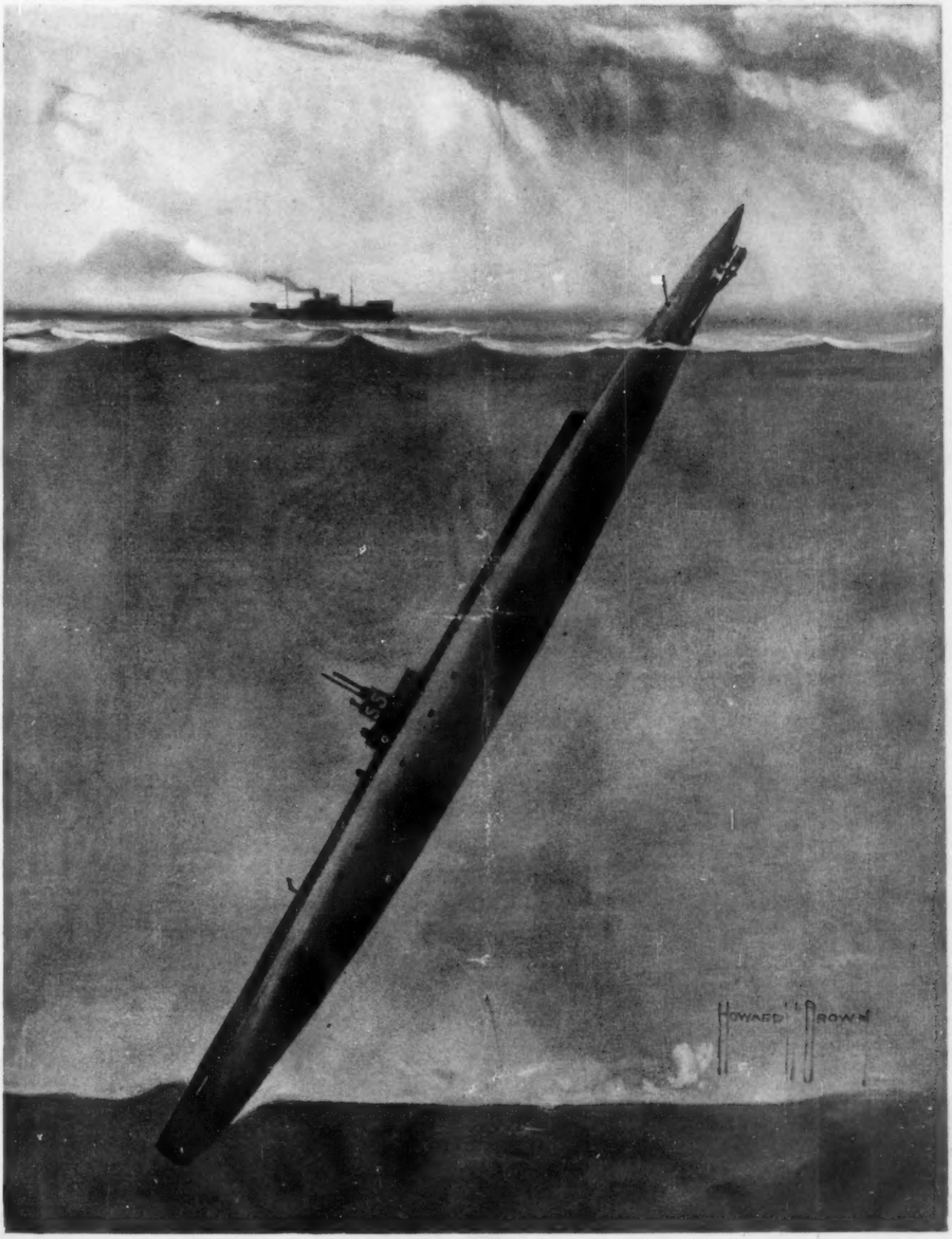
SOLVING THE LABOR PROBLEM
THE TOOLMAKER'S TOOLS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



SUBMARINE S-5 SIGNALLING FOR HELP THROUGH HOLE CUT IN STERN—[See page 298]

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September 25, 1920

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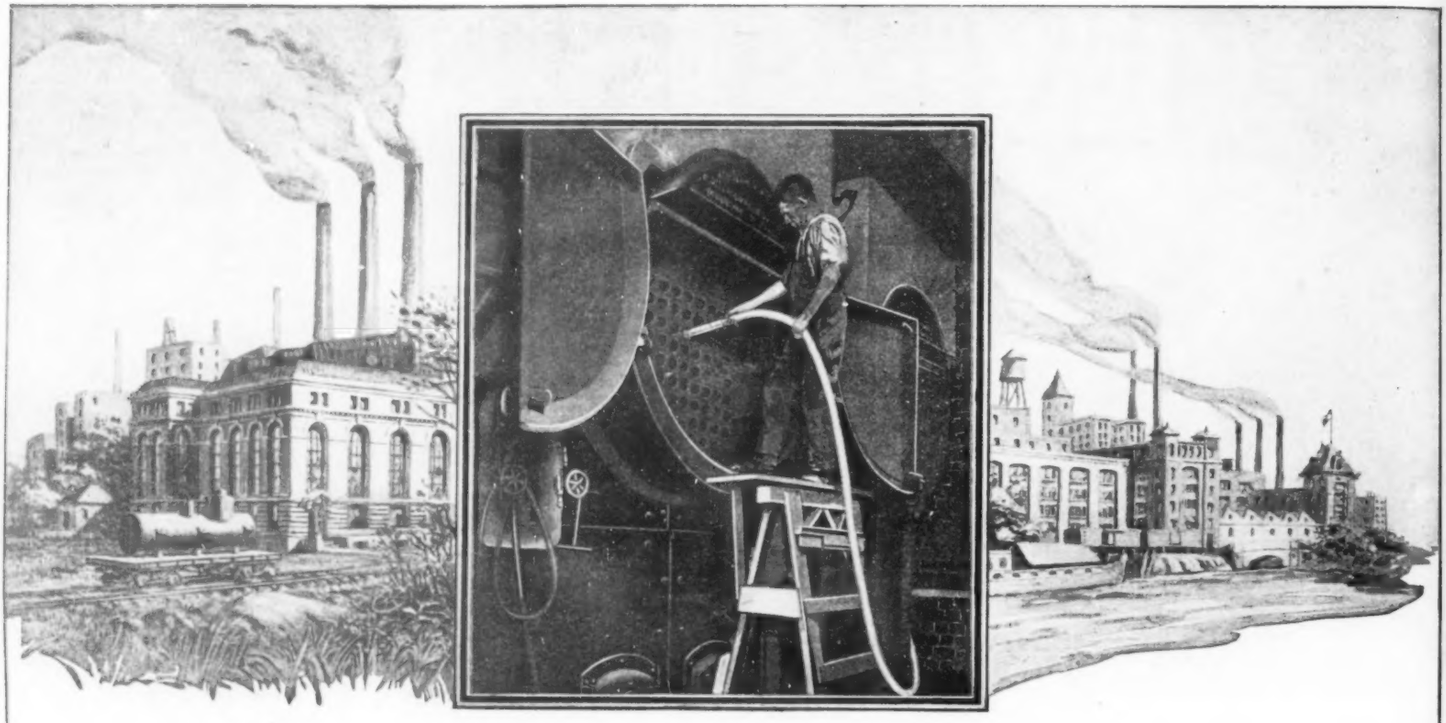

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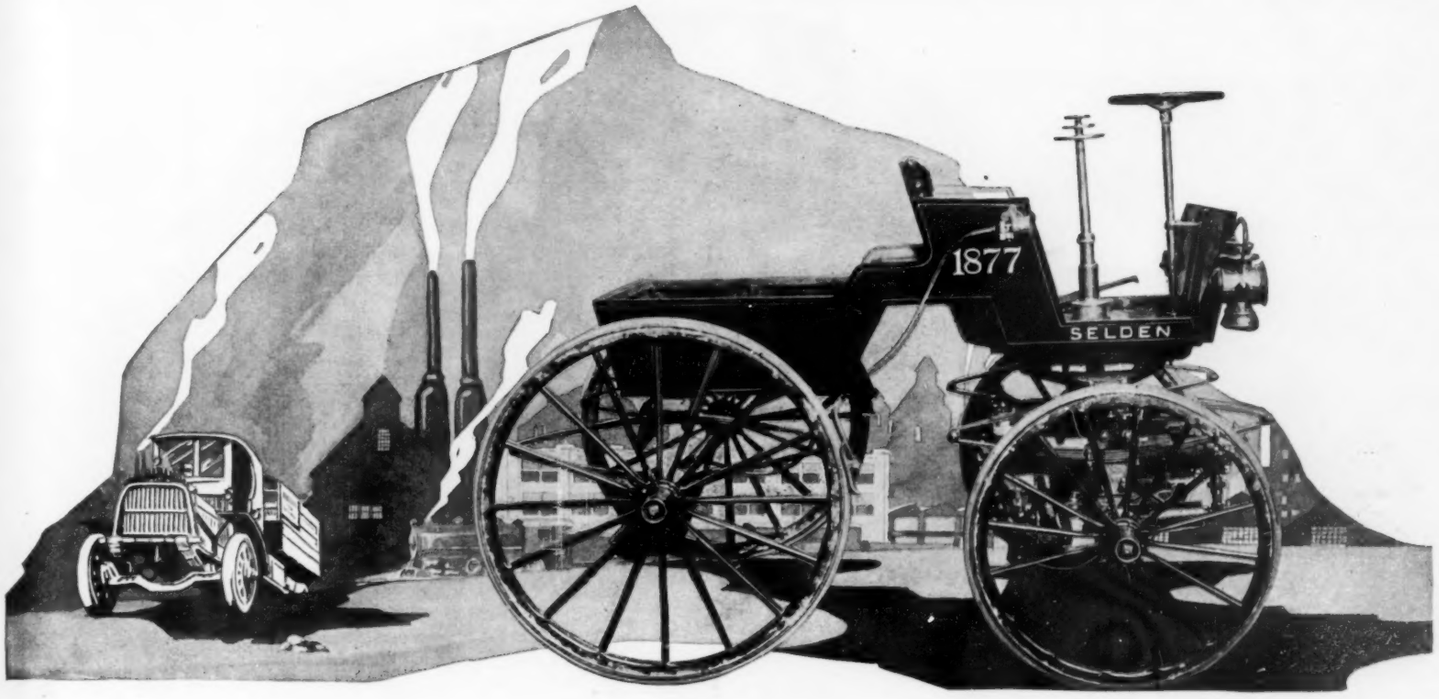

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GEORGE B. SELDEN invented, in 1877, the first internal combustion gasoline engine for road locomotion. This was the beginning of the world's second largest industry.

History affords no more startling record of achievement than the development of the automotive industry, which resulted from this remarkable invention by Selden.

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WRITE for Booklet, "Yesterday, Today, Tomorrow," a brief history of the early days of the automobile

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Selden Motor Trucks

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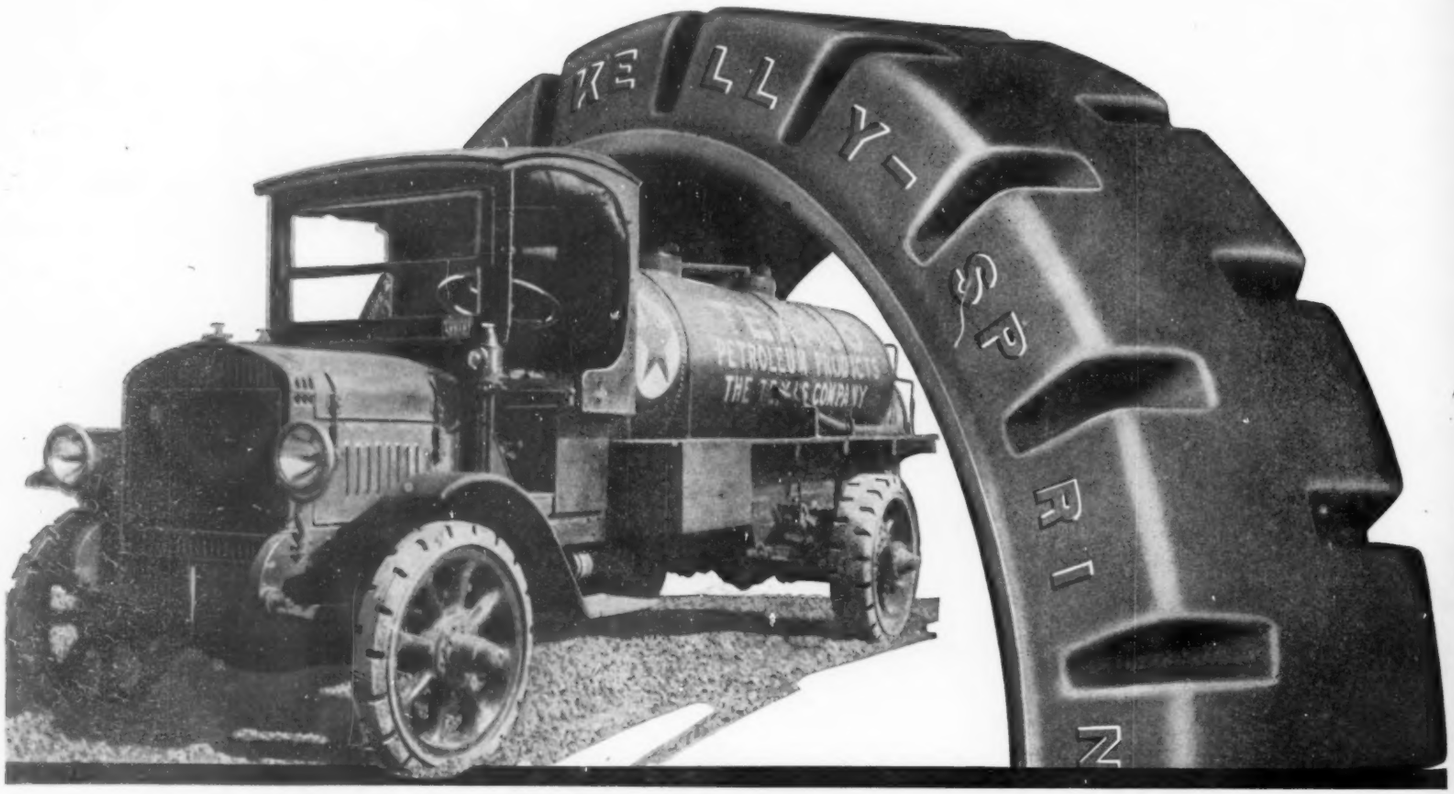

Hard going doesn't stop these wonderful tires

"One thing we like about your Caterpillar tires," writes a big contractor, "is the traction our trucks are able to get with them. Only under the most exceptional conditions do we have to use chains. No matter how heavy the load, our trucks never have any difficulty in climbing out of excavations, and we find that Caterpillar equipment means a substantial saving in gasoline consumption."

The Caterpillar's amazing traction qualities seem to be the feature most frequently commented upon by truck owners; but it has two other equally important advantages.

It cushions the truck, and it gives double the average mileage of any other type of tire.

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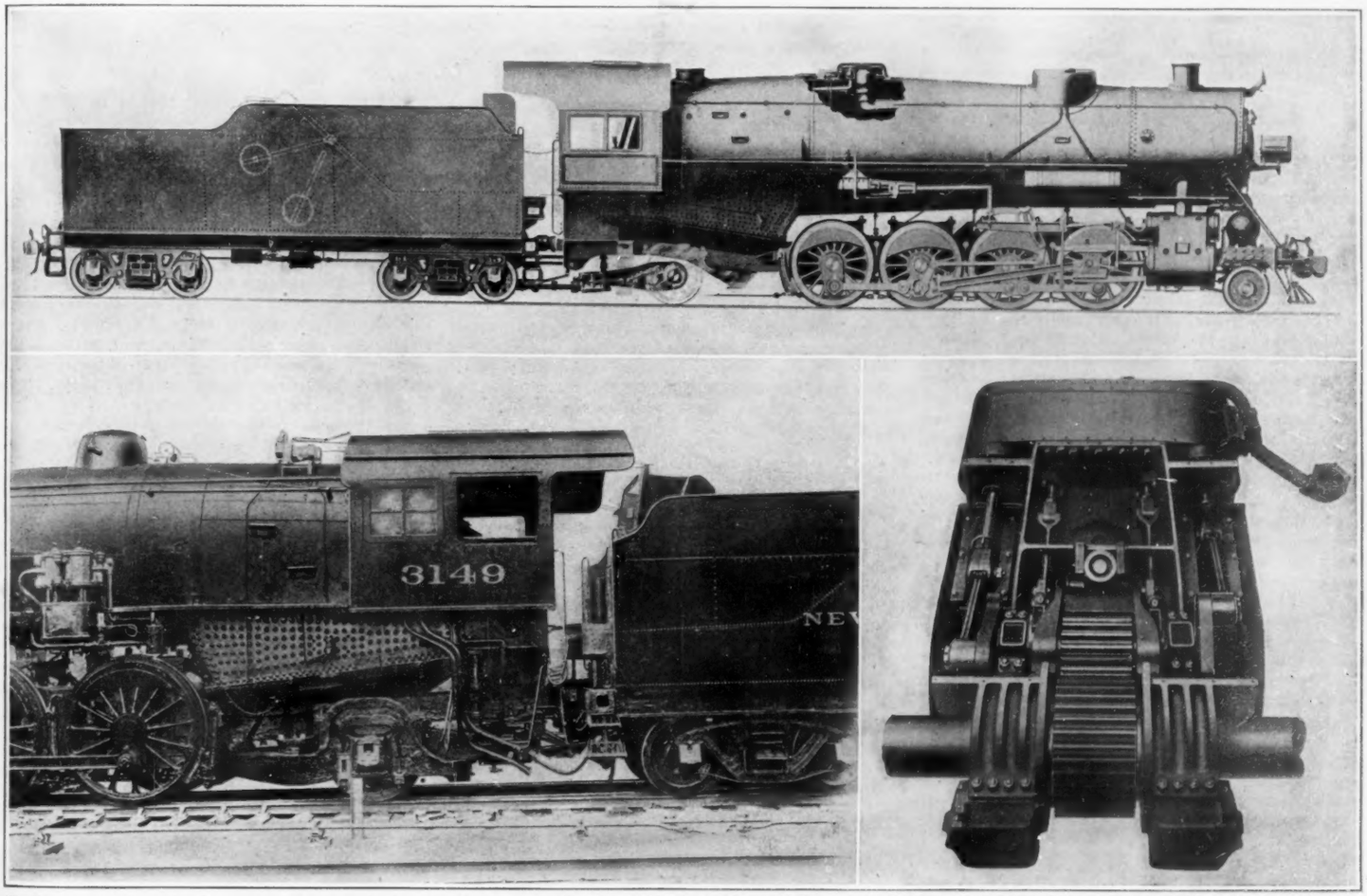
SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 13] NEW YORK, SEPTEMBER 25, 1920 [15 CENTS A COPY 20 CENTS IN CANADA



Broken-away view of a locomotive fitted with the new booster, showing how this device is applied; a view of the rear end of a locomotive so equipped; and a view of the two-cylinder engine and gear drive comprising the booster

More Starting Power for the Steam Locomotive

THE locomotive booster is a power unit applied to the trailing wheels which, by utilizing their full traction, increases the drawbar pull by 25 to 40 per cent (depending upon the type of locomotive) at starting and getting up to road speed, and disengages automatically when the engineer hooks up the reverse lever. This device capitalizes idle weight and spare steam with negligible addition to the weight of the locomotive, and without increased demands on the engineman. Its control is semi-automatic, giving the engineman a maximum resource with a negligible minimum of attention to its operation.

Locomotives recently built employ weights bordering on the limit the track structure will bear. Yet their speed-pull curves nearly coincide with those of lighter engines of the same type. Greater starting and accelerating power is the principal advantage.

The locomotive booster, so it is claimed, gives an increase in starting and accelerating power equal to what 50,000 pounds additional locomotive weight would give. And the booster weighs only 3,500 pounds. So it may be said to avoid large investments for improved roadway and bigger locomotives.

This remarkable device has been hailed by many experts as the greatest advance in steam locomotive engineering in ten years. It reduces by one-half the time required to get trains to road speed. It is said to pay its own fixed and maintenance charges several times by avoiding slipping drivers and the consequent wear and tear on the main locomotive. When the train is up to road speed it has no more effect on the locomotive's operation than so much coal on the tender.

The booster consists of a simple two-cylinder steam engine, secured to and supported by a specially designed cast steel bed plate. This cast steel bed plate contains the axle bearings and supports all moving parts of the booster. Three-point support is provided, two bearings fitting on the trailing axle and a third, which is a ball joint, fitting on the back member of the trailing truck frame. This suspension gives sufficient flexibility to compensate for any torsional movement between trailing truck frame and axle, and in addition the ball joint is located near the center of gravity of the booster engine, thereby relieving the trailing axle of the weight and minimizing wear of the booster bearings.

The piston rod, connecting rod and crank-shaft follow general locomotive practice. The crank-shaft and driving piston are integral and are of heat-treated steel, liberally designed. Lubrication is taken care of by enclosing the entire engine and connections in an oil-tight steel case and using splash method. This automatically lubricates all bearings except the main bearings on the trailing axle, which are lubricated in the same manner as is employed for car journal boxes, *i. e.*, a waste-packed oil box.

The control valves are air-operated. Indeed, practically push-button control is provided. Nothing is left to judgment except the use of the device when needed. All the engineer has to do is to raise the latch on the reverse quadrant. Operating the locomotive in the usual way automatically operates the booster. It can only be brought into operation when the latch on the reverse lever quadrant is in operating position, when the main locomotive throttle is open,

(Continued on page 312)

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

An Announcement

IT is with great regret that we announce the necessity of increasing the subscription price of our publications—a necessity imposed upon us by abnormal conditions in the publishing business. At present prices and under present conditions our publications can be produced only at considerable loss. Our manufacturing costs, barring the single item of paper, have increased 200 per cent; the cost of paper has increased 300 per cent since the beginning of the war; postage under the zone legislation has increased 200 per cent. Like most other publishers, we have hesitated to take the drastic action necessary to meet these increases, until it had become entirely clear that it was a permanent rather than a temporary condition that faces us. Stabilization of business on a new basis has gone sufficiently far for us to be assured now that this higher level of costs will not be materially abated, at least for a long time. In company with conservative publishers everywhere, we therefore find it necessary now to readjust the selling price of our product to conform with the new conditions.

Beginning October 2nd, the price of the SCIENTIFIC AMERICAN will be advanced from five to six dollars, annual subscription; that of the SCIENTIFIC AMERICAN MONTHLY will be advanced from five to seven dollars, annual subscription.

In spite of the serious difficulties which have confronted the publisher during the past twelve months, the high standard of the SCIENTIFIC AMERICAN has been maintained, and the subscriber has been given the same excellent quality of reading matter that we have furnished in the past. The same will be true of the future; we shall continue to cover as we have always covered our field of applied mechanical science, invention and industry.

While it would be impossible to catalog all the features of the coming year, and wearisome even if it were possible, several outstanding high lights clamor for mention. A kind friend of the SCIENTIFIC AMERICAN has offered a prize of five thousand dollars for the best essay on the Einstein theories of relativity, and every thinking person will want to read the winning essay and its close competitors when these begin to appear in our columns. Earnest watchers of the stars follow our monthly astronomical article by Professor Russell with great interest. The tale of the successes which great inventors have attained through the establishment of commercial plants and the development of their inventions will continue in the series of articles "The Romance of Invention." The extraordinarily useful summaries in briefest possible form of the achievements of science and technology here, there and everywhere will continue to make the SCIENTIFIC AMERICAN of the greatest value to the busy man who must know what the world is doing. In the future as in the past the progress of aviation and the other new arts will be fully chronicled.

It is the purpose of the SCIENTIFIC AMERICAN, almost before all else, to publish up-to-date articles upon the latest inventions that are brought to public notice. These discussions are timely and full of interest. It is the policy of the editor, and has been so ever since the days of the notorious "Keeley Motor," to expose fictitious claims which are put forward from time to time in regard to some startling discovery of doubtful authenticity, an especially valuable activity when such claims seem to be developed for financial reasons. The paper is designed to keep the reader informed of the latest news of the day along its particular line, and anyone who is a constant reader of the SCIENTIFIC AMERICAN will find himself to be better informed by such reading, not alone with reference to his own particular line of work but as to what is going on in the scientific and industrial world at large.

To Render Travel by Air Safe

TO those of us who wish to see the future of commercial aviation assured, it is extremely disconcerting to notice that the number of fatal accidents in aviation appears to be on the increase, and this increase, it should be remembered, is not by any means proportional to an increase in the number of machines and pilots; for the rate of increase of accidents is out of all proportion to the growth of flying as a sport and a commercial industry. The details of these ever-recurring accidents as given in the daily press show that far too many of them are due to exhibition flying, air "stunting" and the demands of the "movie" men and the daily press for sensational and novel pictures. Another contributory cause of disasters is the great scarcity of flying fields and proper landing places at a time when great efforts are being made to promote long-distance travel by air.

There can be no denying that the situation is such as calls loudly for government assistance and control. Any day of the year airplanes may be seen flying low over cities and villages, and it is only a month since a machine engaged in photography narrowly missed crashing among an assembled crowd of 10,000 people. There is a growing note of protest against these practices, and it is fully justified by the serious risks to which the public is daily being exposed. We have heard a good deal of talk during the past two or three years about the need for legislation and the formulation of strict laws governing the use of the air; but if any such rules, State or municipal, exist, they are honored more in the breach than in the observance.

The evil of all this lies in the effective way in which it tends to kill that public appreciation and confidence, which is absolutely necessary if commercial aviation is to make any headway in the United States. Unquestionably the perpetually recurring disasters of the past few months, a large proportion of which have happened to skilled pilots of long experience, is doing much to shake public confidence.

That we are not playing the part of alarmists or unduly exaggerating the increasing flying accidents is proved by the fact that in Europe they have found a means to make flying the safe and attractive form of travel which it is entitled to be. Testimony to the truth of this statement comes from that well-known and successful designer of airplanes, Edson F. Gallaudet, who with his associate, W. B. Lebherz, has just returned from a two months' tour of Europe, where they found that the aircraft industry is in the midst of extensive experimentation out of which it is expected there will be evolved new types of material and construction for long-distance aerial transport. In this important work, we are told, the manufacturers even in Germany are receiving the active support of their governments. This support in the case of England and France does not take the form of large appropriations, but consists of the passage and enforcement of laws regulating aerial traffic; licensing of pilots and inspection of aircraft; the prosecution of technical investigations into new metals and alloys which will increase the safety and enhance the durability of machines; and, finally, in the appropriation of small amounts for experimental development sufficient to enable the manufacturers to remain in business, thereby assuring the possession of construction facilities in case of future national need.

Mr. Gallaudet ascribes the present unsatisfactory condition of our airplane industry to the fact that we do not have the advantage of the national coöperation which is enjoyed abroad. He believes that this lack is reflected in America in the repeated number of fatal accidents following our disregard for the common rules of flying.

Thus, we are told that during the two months these gentlemen were in Europe, there was only one airplane accident in England and none in France or Germany of which they heard any mention or saw any record. The result of this immunity is that abroad there is a general confidence in the safety of air travel. They attribute the scarcity of accidents abroad to the existence of severe regulatory national laws and their strict enforcement by centralized aeronautical branches of the Government, which normally makes improbable the dangerous practices which are common in the United States. As an instance of this, they quote the fact that in England a flyer was fined $250 in police court for making several Immelman turns at a height of 500 to 600 feet from the ground. They were given an opportunity to study the actual results of the British national policy of regulating flying and encouraging its development by making it safe. They found that in the preceding twelve months within the British Isles alone, nearly 700,000 miles had been flown by airplanes of all types with only 24 accidents and 4 fatalities.

Setting Our Industrial House in Order

THE conclusion of the war found the nations of Europe with empty storehouses and their stocks of a thousand necessary commodities, both raw and finished, depleted. Until such time as they could set their house in order, they turned to the United States as the only possible provider on the enormous scale demanded by their crying necessities, with the result that our export trade expanded by leaps and bounds to unbelievable figures. It was realized that the conditions were temporary, and the unfavorable rate of exchange, coupled with the unexpectedly rapid return of European industries to normal peace-time conditions, had the inevitable result of greatly reducing the volume of our export trade to Europe.

The slowing down of the foreign demand should have a most favorable effect on the solution of our own great problems of readjustment and reconstruction. Not alone during the war but also in the two years that have passed since the armistice, the industrial effort of the United States has been diverted from its own internal necessities. Our vast railroad system has been so greatly neglected that a conservative estimate by expert railroad officials has placed the total expenditures that must be made before the railroads have caught up with the enormously increased traffic demands, at the huge figure of five billion dollars. Recent favorable legislation and the belated increase in rates will render the railroads, it is hoped, so desirable an investment as to lead the public to invest on a sufficiently generous scale to provide the funds for reconstruction as they are needed.

Another equally urgent domestic problem, intimately bound up with the railroad problem, is that of housing. There can be no return to normal conditions until the present distressing shortage has been relieved. In no direction was our diversion of effort, both during the war and after, so grievously felt as in this matter of providing homes for the people to live in. That a man shall have a roof over his head is a demand only less insistent than that he shall have food in his mouth.

The capital and energies that have been spent so freely in supplying the needs of an impoverished world should now be concentrated very largely on the task of providing sufficient houses for the people to live in. In this matter we have not shown the enterprise with which some of the debt-burdened nations of Europe have taken hold of the problem. There has yet to be formulated a broad, well-thought-out plan; and it would be well if the leaders of both parties would substitute for the reprehensible politics of the day, to which the public shows a contemptuous indifference, a little real constructive legislation on a subject in which the whole country is vitally interested.

There is no doubt that agriculture has suffered greatly by the influx of workers from the country to the cities as the result of the abnormal industrial demands of the war and the post-war expansion of our export trade. Already the closing or slowing down of industrial plants is causing a reversal of the tide of labor. The flow is now from the cities to the country, and agriculture—basis of permanent prosperity—seems about to come, once more, into its own.

Naval and Merchant Marine

The New Navy Hangar.—The new naval hangar at Lakehurst will accommodate two dirigibles, both more than twice as large as R-34. In fact, it will be larger than any hangar in existence. The length is nearly 1,000 feet, the width, 318 feet, and the height, 210 feet. The double doors are each 177 feet high and 136 feet wide.

A Record Parachute Drop.—The official record for a parachute drop has been accredited to Lieutenant John H. Wilson, U.S.A., of the 96th Aero Squadron, Kelly Field, Texas. There has been a question as to whether a parachute would open satisfactorily in rarefied atmosphere. The Lieutenant demonstrated that it would when he leaped from an army airplane at an altitude of 19,861 feet, and seventeen minutes later made a safe landing.

The Question of Personnel in Our Navy.—Representative Fred A. Britten, of the House Committee on Naval Affairs, is right when he says that we should now give our attention to the rounding out of the fleet, the development of the merchant marine and the securing of an adequate and well-trained personnel. The first step to be taken is to secure men for the new ships which are now under construction. The Navy should give equal if not greater attention to the question of personnel than to that of the completion of our new battleships and battle-cruisers.

Panama Canal Traffic.—Traffic through the Panama Canal for the year ending June 30, 1920, exceed that of any previous year. A total of 2,478 merchant ships passed through the Canal with an aggregate net tonnage of 8,545,653 tons. In the fiscal year 1918-19, 2,025 ships pased through the Canal, and their aggregate was 6,131,575 net tons. The aggregate revenues approximated $8,800,000, and the expenses of operation and maintenance were about $6,650,000. This, however, takes no note of the interest charges on the cost of the Canal or of the depreciation of the plant.

Our Latest Battleships and Battle Cruisers.—Our latest battleships of the "Indiana" class, of 43,200 tons displacement and 23 knots speed, carrying twelve 16-inch guns, will be electrically driven. The turbines of 60,000 combined horse-power will develop their full rated load at 265 pounds pressure, 50 degrees superheat, and 28½ inches vacuum. The six new battle-cruisers of 43,500 horse-power and 35 knots speed, carrying eight 16-inch guns, will also be driven electrically. Two of them, the "Ranger" and the "Constellation" will carry four Westinghouse turbines of 49,750 brake horse-power, the current from which will be developed on eight Westinghouse motors, each of 22,500 horse-power.

Franklin Medal to Sir Charles Parsons.—The Franklin medal has been awarded to Sir Charles Parsons "in recognition of his epoch-making success in the development and the construction of the steam turbine which has revolutionized the art of steam engineering, particularly in regard to the propulsion of mercantile and naval vessels, and the driving of electrical generators." Not many people know of the courageous struggle of Sir Charles in the early days of his invention, and that he separated from his original partners owing to their becoming too discouraged to "carry on." *Engineering*, in speaking of the ward, says: "The work of Sir Charles Parsons has halved the cost of producing electric power and reduced in still greater proportion the capital cost of engineering machinery."

The World's Merchant Shipping.—It is estimated by Lloyd's that as a result of the action of enemy submarines and the diversion of resources normally employed in replacing losses and constructing new tonnage, the net reduction in the merchant shipping of the world during the last six years amounted to 3,516,000 tons, this figure being based on the assumption that the ratio of increase during the last six years would have been four-fifths of the average rate of increase during the previous six years. The United Kingdom leads with 18,111,000 tons, and the tonnage for the whole empire, including the British Dominions, is 20,143,000 tons. The United States comes next with 12,406,000 tons, the total for this country having thus grown since 1914 when it was 2,027,000 tons.

Astronomy

The Total Number of Minor Planets.—M. Paul Stroobant, director of the Royal Observatory of Belgium, has made an estimate, by two different methods, of the total number of asteroids, or minor planets, brighter than the 20th magnitude. The result, according to one method, is 57,000, and, according to the other, 100,000. M. Stroobant believes that very few of these bodies brighter than the 12th magnitude remain undiscovered.

A Minor Planet Mistaken for a Comet.—According to *Astronomische Nachrichten*, it has been discovered by F. K. Zweck that the object heretofore known as Comet 1908 *a* (or, in some catalogs, Comet 1907 VI) is identical with the minor planet 516 Amherstia. This body was at first taken for Encke's comet, and afterward for a new comet with a large perihelion distance. The orbits of Encke's comet and Amherstia approach each other within 2,000,000 miles in about longitude 310 deg. and within 5,000,000 in about long. 358.

Unexplained Irregularities in Lunar Motion.—In a recent address before the Astronomical Society of the Pacific on "The Problem of the Moon's Motion," Prof. E. W. Brown discussed, *inter alia*, the curious semi-regular fluctuations of the moon from its theoretical position first discovered by Newcomb. The earth, Mercury and Venus have been found to exhibit deviations of a similar character, though smaller in amount. The irregular character and comparatively great magnitude of these fluctuations, says Prof. Brown, suggest that there is some set of forces acting on the bodies of the solar system related to the known irregular changes in the condition of the sun. The period of rotation of the sun's magnetic axis found at Mount Wilson is sufficiently close to that of one of the principal lunar periodic terms known as the evection to suggest a long-period change by the phenomenon known as resonance. Long continued observation will, however, be necessary to enable us to ascertain the merit of this suggestion.

A Century of the Royal Astronomical Society.—The annual general meeting of the Royal Astronomical Society held last February marked the hundredth anniversary of the foundation of the society, the early history of which was set forth in Prof. Fowler's presidential address. The organization was launched at a meeting held at the Freemasons' Tavern, in London, Jan. 12, 1820, and the prime mover in the undertaking appears to have been the Rev. W. Pearson. The first general meeting of the newly constituted society was held at the rooms of the Geological Society Feb. 8, 1920, thus establishing the custom still maintained of holding the annual meetings in February. The Duke of Somerset was elected president but declined to serve, and the first actual holder of the office was Sir William Herschel. The *Monthly Notices* of the Society, now an indispensable part of the reading of astronomers throughout the world, date from 1827. In 1830 King William IV became patron of the organization and its name was changed from the Astronomical Society of London to the Royal Astronomical Society.

To Determine Australian Longitudes by Radio.—In marking out the boundary between South and West Australia, defined by imperial act as the 129th degree of longitude east of Greenwich, it is proposed to determine an initial point on the line by utilizing longitude signals from a high-power radio station located at some point between Greenwich Observatory, in England, and Sydney Observatory, in Australia, the signals to be received simultaneously at these two points. This undertaking will be the first step in a comprehensive scheme involving the redetermination of the whole longitude system of Australia. A committee has been appointed to carry out the work in Australia, comprising the government astronomers of New South Wales, Victoria, West Australia, and South Australia, the commonwealth surveyor-general, and the director of the Royal Australian Navy Radio Service. It has been ascertained that, under favorable conditions, signals from Lyons can be successfully received in Australia as well as at Greenwich, and signals from other stations more symmetrically situated are also being tested. The coöperation of the United States, as well as the British Government, has been invited.

Automobiles

Material Market Limits Car Production.—One of our mechanical contemporaries, *Machinery*, states that the automobile industries appear to be fairly well supplied with machine tools for present requirements, though some of the larger companies are still buying. Gear manufacturers are exceedingly active, and a large percentage—in some cases from 75 to 80 per cent—of their product goes to the automobile and truck industries. It is estimated that the output of the automobile and truck builders for this year will amount to 2,250,000 cars. It may not be possible for all the automobile builders to complete as many cars as planned on account of the decided shortage of certain classes of material. Sheet steel is scarce, and cold-rolled stock of some sizes can be had only in small quantities. This is a serious drawback in the metal-working industries.

Belgian Auto Industry.—Before the war there were twelve automobile factories in Belgium, located in the neighborhood of Liege, Charlerol, Brussels and Antwerp, employing 4,000 to 5,000 men. The annual production, chiefly private cars and motorcycles approximated 4,500 to 5,000 automobiles and chassis and 7,000 to 8,000 motorcycles, with a total value of some $11,000,000. Mass production in series of standard types of automobile is not characteristic of the Belgian plants, but special attention is given to the construction of engines and in satisfying the foreign market, especially South America, as to form and decoration. There is a market in Belgium at the present time for American automobiles. The machines desired are those of a moderate price. It is necessary that they be strongly built as many Belgian roads are of cobblestone construction.

Inspect Ignition System.—The ignition system of an automobile should be inspected carefully to learn if all wires are intact, that the terminals are bright and clean, and the insulation is not saturated with oil or grease. The terminals should all be soldered and the wiring should be taped wherever it may chafe. The spark plugs should be taken out, disassembled and cleaned with gasoline. If the porcelains are heavily coated with carbon they can be soaked in kerosene until it softens, when it can be wiped off. Don't scrape the porcelain, as this may remove the glaze. The shells should be cleaned by scraping. When assembling, care should be taken not to seat the insulators too tightly upon the gaskets, but the plugs should endure a pressure of 250 to 300 pounds without leakage at the gaskets. The spark plug points should be scraped or polished bright and set 1/64 inch apart if magneto-ignition and the thickness of a dime worn smooth if battery ignition. The breaker box and distributor of the magneto can be cleaned by blowing out the dust with an automobile tire pump and by wiping with a cloth dampened with gasoline. The distributer or timer should be similarly cleansed.

Why Clutch Acts Harshly.—A grabbing action of the cone clutch is occasioned either by the leather facing becoming very dry through use or by wear, causing the rivet heads to protrude above the leather face and come in contact with the metal of the flywheel. A dry clutch can be restored by sponging off the face of the leather with kerosene and applying a dressing of either neats-foot oil or castor oil till the leather again becomes soft and pliable. If the leather facing is worn down to such a point that the heads of the rivets come in contact with the metal cone of the flywheel, the clutch will stick, and to restore the clutch it will be necessary to drive down the rivet heads into the leather so as to clear the cone. Leather facing that has become rough or uneven through wear can be restored by rubbing off the high spots with emery cloth, broken glass, a coarse file, or sand paper, making the surface smooth. A new leather should not be refitted unless you are absolutely certain that the old leather cannot be reclaimed. When new leather is refitted, it is best to take the car to some good repairer and have him purchase a facing from the factory and fit it correctly. After the new leather has been fitted it will take some time for it to fit itself to the cone of the flywheel and in the meantime it will require frequent dressings with either neats-foot or castor oil.

Left: S-5 running at the surface. *Right:* Stern of S-5 within which the crew gathered and through which, by cutting the plating, they were rescued

The Disaster to One of Our Latest Submarines

How an Air Valve, Inadvertently Left Open, Caused S-5 to Plunge to the Bottom

THE story of the sinking of S-5, one of our latest submarines and of the fight for life, lasting for thirty-seven hours, of the officers and crew, forms one of the most dramatic among the many weird experiences which have befallen various submarines during the past twenty-five years. It is not our purpose here to tell in detail the story of the desperate struggle of the entombed crew to escape. That has been done in very full detail in the daily press by the commanding officer of the vessel, Lieutenant Commander Charles N. Cooke.

The S-5 left Boston on a Monday on a 72-hour endurance run to Baltimore, during which everything functioned satisfactorily. On the following Wednesday she made a "crash dive" at a point 55 miles southeast of the Delaware Capes. The vessel responded to the diving rudders, but failed to straighten out after submergence and dived down until her bow was embedded in the sea bottom. Ultimately by blowing out the main and after tanks, the stern was lifted until the vessel stood in the position shown on the cover of this issue. The crew cut out a small hole through the projecting stern and by means of a brass rod with a sailor's undershirt tied to it, managed to attract attention. Finally, after thirty-seven hours of peril, a hole was cut by the rescuing ships through the hull of the submarine of sufficient size for the rescue of the crew.

It is gratifying to read the following statement in the story of the disaster as given by the Commander: "Next to my inexpressible admiration and praise for every officer and man in my crew and my pride in their courage and fortitude, my deepest feelings are those of gratitude to the officers and crews of the "Alanthus" and the "General Goethals" who so heroically and tirelessly labored to effect our rescue."

With a view to explaining what happened to S-5, we publish an approximate longitudinal section of the vessel, showing in a general way the various compartments and the ballast and trimming tanks, together with the position of the air valves and piping through which the water which sank the vessel found entrance. Successively, the various bulkheads divide the submarine into a forward trimming tank, a torpedo room, crews quarters, central control compartment, engine room, motor room, and after trimming tank. In the lower part of these compartments there are also the forward and after ballast tanks, the main ballast tanks and the fuel tanks, together with the accumulator batteries.

Contrary to popular conception, a submarine spends ninety to ninety-five per cent of its time upon the surface, and navigation, even in war time, takes place on the surface except when enemy ships are in sight or an attack is to be made. When the vessel is submerged, all bulkheads, manholes, et cetera, are tightly closed; but when running on the surface the bulkheads are open throughout the vessel and ventilation is secured by means of a system of air pipes connected with the outside atmosphere and provided with valves where the pipe enters the various compartments. In our sketch, this pipe is shown by a heavy black line. The intake is by means of a vertical pipe terminating outside the hull, in rear of the conning tower, and provided there with a valve, which is operated by means of a hand-wheel and vertical rod from the central control compartment within the hull. The vertical pipe connects with a horizontal air pipe, which is laid along the outside of the hull proper of the submarine and has connections with the torpedo room, the central control compartment, the engine room and the motor room. The passage of the air into the various rooms is controlled by overhead hand-operated valves as shown in the drawing.

When the submarine is running at the surface, these ventilating pipes with their valves are all open and the bulkhead doors connecting the various compartments are also open. Fresh air is drawn into the submarine, passes through its whole length and is ultimately drawn into the engine and discharged through the engine exhaust.

At the time the accident happened, the S-5 was making what is known as a "crash dive." To make this dive the vessel is first brought awash with her ballast tanks filled and with some fifty to one hundred pounds of positive buoyancy. When the order to dive is given a klaxon horn sounds in the various compartments and all doors are closed and all ventilating valves shut down, including the one abaft the conning tower. The oil engine is disconnected and the motors are connected up and started. The diving rudders are then depressed sufficiently to cause the submarine to descend at an angle of about eleven or twelve degrees with the surface. In a crash dive a well-balanced submarine with an expert crew can pass out of sight in from 48 to 52 seconds.

In making the dive off the Delaware Capes everything went according to schedule until Commander Cooke elevated his diving rudders to bring the S-5 to a level keel. Instead of responding, she kept on going, and finally drove her nose into the mud with a jar which was felt throughout the vessel. Immediately a man from the torpedo room ran into the central control compartment and reported that the torpedo compartment was flooding through the air valve. Water also began to come into the engine room, and it was at once evident to Commander Cooke that the ventilating system was more or less open to the sea and that the valve at the top of the conning tower was open. Efforts were made to close the valve in the torpedo room, but without avail. Subsequently, and with much difficulty because of the steep inclination of the vessel, the various bulkheads were closed and the men drawn aft until the whole of the crew were in the three after compartments, the aftermost air valve in the motor room being tightly closed and the room free from water.

The S-5 had gone down in about 155 feet of water, and although her inclination was about sixty degrees, her great length of 231 feet sufficed to bring some

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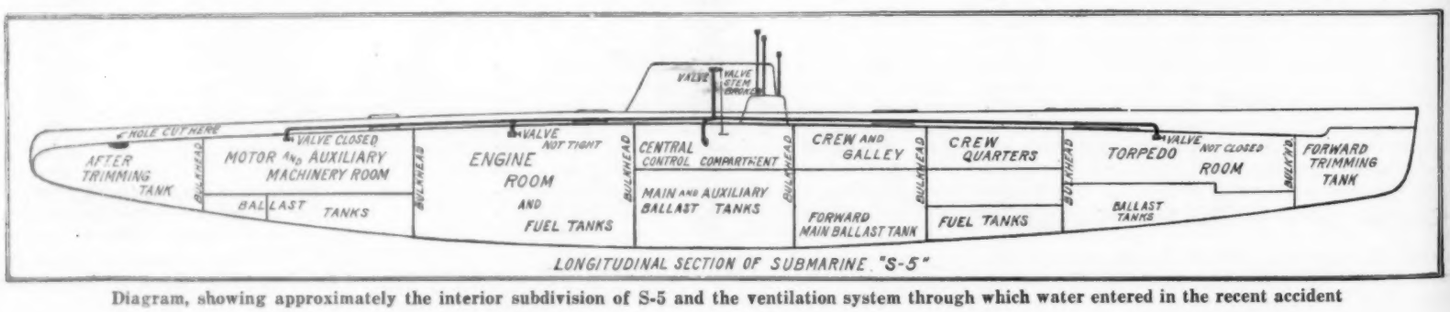
THE outstanding lessons of the sinking of S-5 are first the imperative need for making up the complement of a submarine crew from the older enlisted men and, secondly, the insistent demand in the submarine service for that eternal vigilance which in this mechanical age is more than ever the price of safety. Before the war, submarine crews were selected from men in their second and third year of enlistment, and it was common to find a crew made up entirely of petty officers. The majority of these experienced men left the Navy for shore jobs that would enable them to live. The younger men of recent enlistment have not yet attained that automatic impulse to do the right thing in an emergency, which comes with lengthy service.—THE EDITOR.



Diagram, showing approximately the interior subdivision of S-5 and the ventilation system through which water entered in the recent accident

Timing the Hundred-Mile-Per-Hour Racer

By Ralph Howard

TIMING meteors or mammoth steel projectiles hurtled through space from America's biggest naval guns should be a task almost as easy as the accurate timing of automobiles speeding around oval race courses or on straightaway speed stretches, especially when Tommy Milton, the newest speed ace, cuts loose in his sixteen-cylinder Duesenberg racer at the rate of 156.047 miles per hour.

The human eye cannot discern a steel projectile in flight, so rapidly does it travel. And it is almost all the human eye can do to discern distinctly the speeding Milton when he steps on the gas pedals. He usually is just a blur. Experimental time computation tests conducted on a naval coast gun, have shown its 380-pound projectiles to have traveled 17,881 yards in 50.53 seconds. Actual time records show Milton to have traveled a mile in 23.7 seconds or 3752.32 yards in 50.53 seconds, while the projectile was going 17,881 yards. Therefore the steel missile, traveling at the speed of a mile and a fraction under five seconds, went only 4.76 times faster than Milton.

The projectile's speed was computed by measuring the time required for it to pass over a given space. But the time of Tommy Milton's record-breaking speed dash was accurately caught to the hundredth part of a second, the same as the time of every one of the twenty-three racers speeding around the Indianapolis oval recently, was caught on every lap to the hundredth part of a second by means of one of the most remarkable and most sensitively tuned instruments ever conceived in the brain of man.

Catching the time of twenty-three cars, all going at a speed varying from 88 to 93 miles an hour, on every one of 200 laps for each car—a total of 4,600 separate operations for the timing instrument—is not an easy task. It is a particularly difficult task when half a dozen snorting, lurching racing machines sweep past the timing stand in a bunch, for the separate time of every car must be caught accurately, even when there is only five-hundredths of a second's difference in time between the cars.

Otis A. Porter is the man who handles the timing of the Indianapolis speedway races. The timing instrument he uses is an assemblage of delicately tuned electrically corelated mechanical devices, and is so extremely sensitive that it registers in fractions of seconds up to even one two-hundredth part. Upon the precision and accuracy of this intricate machine naturally depends very largely the success and outcome of the race. One second's laying down on the job, one tiny slip-up, and some driver may be robbed of a well-earned victory. One hesitation in the operation of the instrument and the time of a dozen cars thundering down the speedway stretch may be lost, causing subsequent confusion and creating almost a hopeless muddle.

The important mechanism consists of a series of disks, four in number, with raised numerals, each disk graduated. The first disk, registering in hours, is connected with a second disk graduated in sixtieth parts and registering minutes. The third disk, similarly graduated, register seconds, and is connected with a fourth disk graduated in hundredths. The latter is connected electrically with the second hand of a ship chronometer. Every tick of the second hand sends the wheel around in one complete revolution, and every revolution of the hundredths disk "kicks over" the disk registering seconds. In turn every revolution of the second disk "kicks over" the minute disk one notch. A small steel wire stretched across the speedway course connects with the timing instrument. Whenever a car passes over the wire, the contact through electrical stimulus causes the timing device to record the time. A striking arm above the four disks strikes on a strip of paper, registering the imprint of the numerals on the four disks. The machine recovers from each operation quickly enough to permit another registration with less than five hundredths of a second elapsing. On a machine running 60 miles an hour, it is thus possible to catch the time of both the front and rear wheels as they pass over the wire, the two registrations showing four hundredths of a second difference. But when a car is exceeding 60 miles an hour the rear wheels do not register, the front wheels depressing the wire and the rear wheels whizzing over before the wire can rebound from the first impression.

As each car passes over the wire, an assistant calls out its number, the timer marking this number opposite the time recorded on the paper tape which is shifted forward with each registration. Scorers tabulate the laps made by each car, while the timer's assistants, by subtracting the time of the preceding lap from the last registration made, obtains the lap time and from it tabulates each car's complete lap performance and total time.

When Ralph DePalma qualified for the Speedway races on May 26 he made a new track record, ripping off four laps or ten miles in the total time of six

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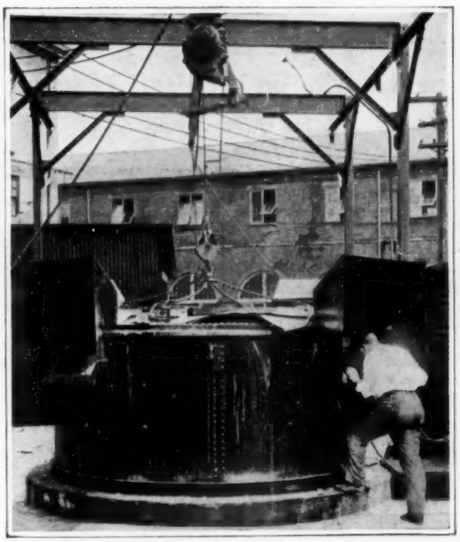


Explosion-proof motor-testing gallery, with the chamber closed and the operator in position for observing results of tests

Bomb-proof Coal Mining

By S. R. Winters

THE use of electricity in cutting coal is a desirable feature because it is easily adaptable to varying forms of service. However, apparatus heretofore used in fire-damp atmospheres—an explosive mixture of natural gas and air—was of such a character as to render extremely dangerous the use of electricity in mining coal. The recently approved explosion-proof coal-cutting equipment overcomes this major objection, according to claims. The testing outfit was coöperatively designed by the Bureau of Mines and a manufacturer of Columbus, Ohio, the latter constructing and installing the equipment as a gift to the Government.

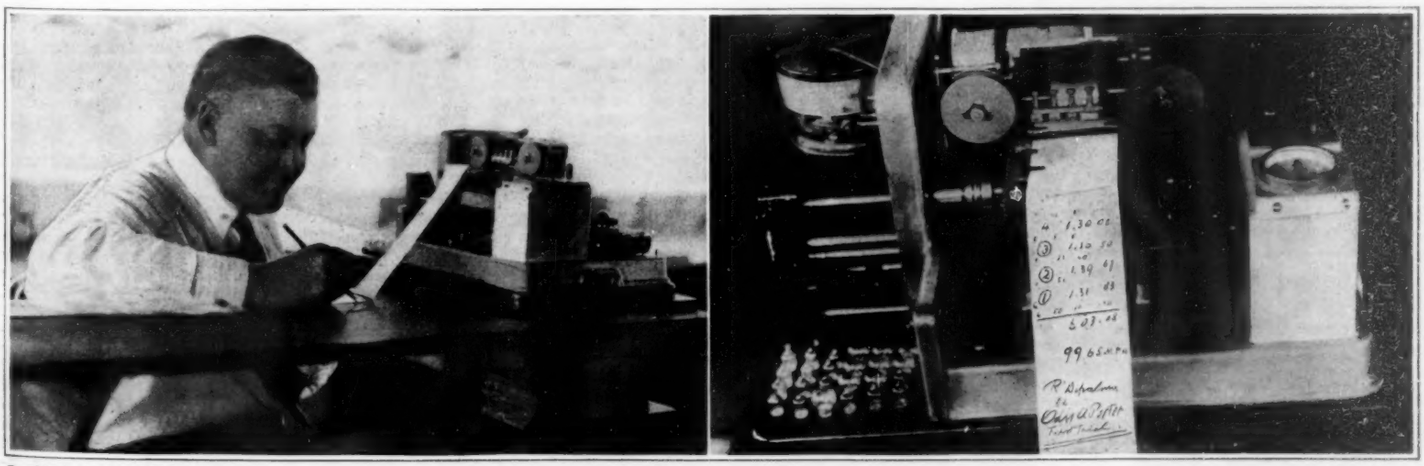
The explosion chamber of the Bureau's testing outfit is composed of a cylindrical steel tank, the internal diameter being 10 feet and the height 4½ feet. The cylinder is located in an iron channel-ring which is imbedded in a concrete base; the joint between the cylinder and the channel-iron is gas-tight through the agency of a water seal. There are four observation windows, the operator being protected from flames emitting from the top of the chamber by hoods. Canvas curtains are available for darkening the interior, thus facilitating a keener view of the results of the explosion. When the gas has been exploded the pressure is released by oiled-paper heads, which are held in position by iron rings. The bomb-proof gallery when not in use is preserved from the weathering elements by sheet-iron covers.

A fan and circulating system make possible the maintenance of uniform mixture of gas and air in the chamber as well as in the motor and other apparatus under test. The explosive mixture is discharged into the bottom of the chamber at two opposite points, the outlets being six inches from the cylindrical wall and so constituted as to give the gas and air a rotary motion. The gallery atmosphere and the entering gas are mixed in desirable proportions. The main suction line from the fan enters the chamber floor near its center.

Mounted on the switchboard are the controller for operating the crane-hoist motor, the switch mechanism which times the ignition with the release of the indicator drum, and the switch for operating the circulating fan and other circuits connected with the testing gallery. Below the switchboard are chains for opening and closing the valves in the piping connections of the equipment subjected to test. The operator is thus given the opportunity of filling one or more compartments with the gaseous mixture. A 3-ton electric hoist raises and lowers the cover or shifts the equipment in or out of the chamber, and is even capable of lifting the cylinder from the concrete base. Following each test the cover of the testing gallery is elevated to air out the chamber and permit of the entrance of the operator.

Conservation in De-gumming Silk

IT is claimed that by a recent process raw silk may be de-gummed without the use of soap. It is proposed to treat the silk under pressure with water containing a small quantity of ammonia, borax, caustic soda, soda ash, or other alkali of similar character, for one-half hour. Distilled water is used as the solvent and the pressure employed is seven pounds.



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Left: Otis A. Porter, official A. A. A. timer, in the act of timing cars during the Indianapolis 500-mile race held on May 31st last. *Right:* General view of the electric timing device which times automobile racing cars to the hundredth part of a second, registering each car's time on the tape shown, by means of an electrical contact and the co-operation of a ship's chronometer. The tape shown here carries the actual record of DePalma's record-breaking four-lap dash of 10 miles at a speed of 99.65 miles per hour

An official timer of automobile races and the electric device that records the speed of each car

The Oil-Field Geologist

How Science Has Made Gambling on Petroleum Prospects a Thing of the Past

By O. R. Geyer

THERE is no more entertaining romance of the oil fields today than that of the oil field scientist, or geologist, whose discoveries have revolutionized the oil industry of the world and who, in the immediate future, will lead the desperate battle to bolster up the production of oil until it can more closely keep pace with the tremendous demand for crude and refined oil products.

Fewer than a dozen years ago the man who professed to be able to discover the location of Nature's secret oil pools without first running the hazardous risk of sinking test wells was about as popular in the oil fields as the fool who plays with matches in the vicinity of a newly tapped gas pocket. Hardened gamblers who had won and lost fortunes by "wildcatting" for oil pools looked upon the geologist with contempt and scorn. This was especially true in the oil fields of the West and Southwest, where the work of geologists in the Appalachian fields was not regarded as a serious contribution to the work of unlocking the vast storehouses of oil so craftily hidden by Dame Nature.

Conditions have changed vastly since those days in which the Mid-Continent field of Kansas and Oklahoma first smashed all records for production. Today the oil field geologist is a highly respected expert, and so great is the demand for his services that there is not enough of him to go around. Schools and colleges which specialize in turning out full-fledged geologists able to cope with the oil game cannot graduate them fast enough these days, and it will be many years before this type of expert becomes a drug upon the market. In fact, the demand for his services will increase in the same ratio as the consumption of oil increases over production.

The conservatism and efficiency of science have long since replaced the methods of the old-time "wildcatter." The oil barons are no longer content with "hit and miss" methods and are paying exceedingly well for the services of men who can reduce to a minimum the dry holes which plague the most resourceful leaders of the industry. The commissions earned by the geologists who have been successful in discovering new oil fields mount into fabulous sums. Many of these experts have long since become millionaires, fees of $500,000 or more belonging to the common, or garden, variety.

The discovery of the Ranger, Burkburnett and Homer pools in the Southwest can be attributed in no small measure to the work of some of the best known oil geologists in the country. The Ranger and Burkburnett fields had scarcely been converted into "proven" territory before these experts were dashing out to all corners of the world in their frantic search for new oil pools. Today there is scarcely a nation in the world which cannot boast of the presence of one or more of these experts engaged in mapping out likely fields for the work of the prospector. Because of the ever-increasing inroads being made upon the reserve supply of oil, this search is approaching the stage of desperation. Even now experts are hinting broadly that the undeveloped oil fields can scarcely supply the world's needs for more than another quarter of a century.

Fuel oil has been substituted for coal as the motive power for hundreds of steamships, and this, too, has contributed to the enormous drain being made upon the country's reserve supplies of crude oil. A year ago it was estimated that the country's oil fields would have to increase their production by 50,000,000 barrels a year to prevent further inroads into the reserve supply. The demand for crude oil and its products has increased enormously since then, making it necessary for an even greater increase in production in case supply and demand are to be kept on even terms.

Hence the importance of the geologist. Thousands of these experts are combing the world today for possible oil "structures." Alaska, Canada, Mexico, Colombia, Venezuela, Brazil, Trinidad, Cuba, Russia, Rumania, Alsace-Lorraine, Germany, Great Britain, France, and various parts of Asia and Africa today are under the watchful eyes of oil geologists. Hundreds of millions of dollars must be expended in this work of prospecting and sinking test wells in all corners of the world, and there are billions awaiting those who are successful in the prosecution of this world-wide game of hide-and-seek with Dame Nature.

There is scarcely a paying field in Oklahoma or the Southwest whose location was not known definitely to geologists long before the drill began pounding its way into the bosom of the earth. Notwithstanding the excellent record established by science in locating oil pools, it is by no means perfect as yet. In proven territory it comes very close to a 100 per cent score, because in such cases the problem is not to locate new pools but to find the most advantageous point for the sinking of new wells.

Many of the larger and more conservative companies have drilling records of from 75 to 90 per cent in the way of successful producers, although many of these wells have been sunk in more or less unproven territory. Geology has done this, of course, and as experience multiplies there is no reason why this record should not be improved. The importance of advance knowledge of the location of oil pools will readily be understood when one appreciates the high cost of drilling these days. In Texas, where the oil sands are located from 2,000 to 4,000 feet beneath the earth's surface, an ordinary well costs from $25,000 to $50,000, and failures are exceedingly trying upon the pocketbook, especially in the case of the shoestring operator.

The remarkable results obtained by some of the best known geologists in picking out likely locations for wells and in casting out the bad spots would fill a book. The success enjoyed by one Sullivan, the geologist who mapped out the immensely prolific Burkburnett pool, is only one of the striking examples of the proper procedure in the exploitation of new oil fields.

HOW many of those discriminating investors who try to separate the sheep from the goats when they turn to oil stocks for investment realize that they are here backing science to unlock the secrets of Nature's storehouse of liquid gold? How many of them understand the revolution in methods which has come over the oil fields in the past ten years? No longer does the "wild-catter" flourish, the man who drilled for oil because he had a lucky "hunch," or because he thought maybe oil was there. Today the geologist precedes the driller, and while he cannot show a clean score of successful predictions, he has vastly reduced the hazard of unprofitable boring. How he has achieved this and what his success means to the industry are the theme of the present story.—THE EDITOR.

Two years ago, when the rumbles of the approaching oil discoveries that were to startle all the world were heard in Texas, Sullivan was sent into what is now known as the Burkburnett district to prospect for likely oil pools. He studied this field exhaustively for miles in all directions, and mapped out what appeared to him every spot that could be drilled successfully as well as probable duster territory. Since that time hundreds of wells have been drilled in this territory, and so carefully did Sullivan select the sheep from the goats that oil men generally have scored him as a 100 per cent geologist.

The work of the geologist is based upon the anticline theory perfected in recent years. An anticline, one finds on consulting Webster, is "a fold or arch of rock strata dipping in opposite directions from an axis." Oil wells are drilled on these anticlines, commonly called drilling on "dome" or "structure." Geologists have found that the rock and sand strata in anticlines formed by the earth's convulsions are more productive of oil and gas than any other earth formation, and this has made the work of the prospector much easier than in the days of "wildcatting."

In beginning his work the geologist first seeks to find an unbroken fold or anticline of rock. He knows that in the pocket thus formed by nature he may find a pool of oil. This is by no means certain, however, for any number of things may have contributed to the lack of oil. The first and most probable is that a concealed break, hundreds of feet below the surface, may have allowed the gas and oil stored there to escape hundreds or thousands of years ago. The pool might have been formed as the result of one upheaval of rock, only to be drained by a second shock coming centuries later. Earthquakes, for instance, have a sly habit of wrecking profitable oil fields by opening up new cracks and crevices hundreds of feet down in the earth and allowing the oil to escape into new pockets and pools. The skill of the geologist is of little avail in locating these hidden mysteries.

Three important factors enter into the accumulation of gas or oil beneath the earth's surface, geologists have discovered. The first is a favorable structure—anticline or monocline. The second is a good open sand, and the third the right height of structure with reference to salt water. Of these three factors only the first can be determined more or less definitely before drilling, and there is always the chance that a freakish twist or convulsion of nature has destroyed the "scent" followed by the scientist.

The development of oil field geological research dates back to the time of Dr. I. C. White, who surveyed what are known as the West Virginia, or Appalachian, fields. His reports on oil "structures" in that field have formed to a large extent the basis for investigations in all other fields. Later other pioneers took up this work in Pennsylvania and Illinois, but the Mid-Continent fields had become the country's principal producing district before this science had gained a foothold in the Southwest. Almost all of the discoveries which made Oklahoma the greatest oil producing State for a time were the result of geological investigation. The Cushing field, which will go down into history as the world's greatest oil pool unless some new record breaking discovery remains to be made, was brought in at the insistence of geologists.

Since those pioneer days commercial geologists have been turned out in large numbers to meet the demands of the oil barons of the South and Southwest. A short course for oil field geologists, patterned after the short course idea which revolutionized farming methods in the Middle West, was established some years ago by an Oklahoma college as a means of overcoming the shortage of geologists. Since then the student roll of every college specializing in this work has been carefully scanned by the great oil companies for any possible additions to their staffs.

The rewards paid geologists who have made a success of their work in the Southwest make them the country's highest paid scientists. Fees received by some of these experts have been enormous, and it is a poor geologist indeed who cannot command a salary well up in four or five figures. Oklahomans are fond of telling of the two Vandruffs, father and son, who stopped off in the Oklahoma fields at the invitation of one of the oil companies. The president of this concern was anxious to discover a new field which would enable his company to maintain its rate of production far into the future. The two experts, who had originally intended to locate in California, were sent into the wilds of a rough and hilly section of the State which had been scorned heretofore by oil men.

They spent weeks making a minute examination of the rock formations, and as rapidly as their work was completed lease men employed by the company followed them up, signing up all approved property at moderate sums. When the Vandruffs completed their investigations, this company had obtained leases on 6,000 acres of property which had been scorned by more conservative oil men. As their fee, the father and son received a one-eighth interest in the property. Some months later the first well was brought in and a prolific producing pool worth many millions of dollars had been revealed. The two disposed of their interest for $500,000, a princely sum in those days.

The rewards to be gained by oil field geologists have been by no means exhausted, and will continue to mount and grow as prospectors continue their one-sided game of hide-and-seek with Dame Nature. At the present rate of consumption America must increase her production of crude oil at the rate of more than 40,000,000 barrels a year if she is to keep pace with her own needs. In 1919 more than 400,000,000 barrels of oil were required to meet domestic needs.

Improvements in Screw Measuring Machines

DR. P. E. SHAW, of University College, Nottingham, England, has further improved his screw-measuring machine, which has already been mentioned in these columns. The new machine appears to be very simple in construction and rapid in operation. All the movements are sliding, thus greatly reducing the time needed as compared with the tedious manipulation of the ordinary micrometer devices. One special merit claimed for the new machine is that it is equally applicable to plug and ring screws. There appears no reason to doubt that this claim is correct, in which case a distinct advance in meterology will have been secured, as the present method of measuring ring screws by means of standard plugs is not only tedious but requires a costly outlay for apparatus. The accuracy of the new machine is stated to be to 1-5,000th of an inch on diameters, and 1-20,000 on pitches, both in the case of plug and ring screws, thus satisfying the highest requirements of ordinary practice.

Chemistry Applied to Safety

THE National Safety Council is responsible for an investigation undertaken at the Bureau of Standards to determine the action of hydrochloric acid on manila rope. When brick work is washed down, the commercial grade of hydrochloric acid known as muriatic acid is commonly employed, the men working from staging supported by manila rope used in blocks and falls. Accidents have occurred because of the rope becoming weakened through contact with the acid or its fumes, and the action takes place without any superficial trace being noticeable to the eye. Serious accidents have resulted, hence it is now suggested that the rope be treated with some acid-resisting compound. This portion of the investigation is now under way, especially with reference to ascertaining the protection which would be afforded the rope by the use of compounds which have proven effective in protecting machinery and similar equipment from acid corrosion.

Purifying Oil by Centrifugal Action

FOR many years there has been in use in most of the large engineering works of this country a centrifugal separating machine which removes the oil from iron and steel turnings or borings, and thus permits it to be used over again. The idea which underlies this machine has now been carried further and applied to the removal of the dust and dirt which unavoidably collect in oil used in the lubricating systems of marine and other large engines. The new machine is very similar in form and operates on the same principle as the now well-known centrifugal cream separator. The foul oil is fed continuously into the machine through a strainer which catches any gross particles, precisely as milk is fed into the cream separator. The purified oil escapes continuously, while the dust and dirt collect on the inner surface of the separating drum. Provision is made by which the attendant can instantly tell when the machine is choked with the deposited impurities.

Rotatable Coal Hopper for Locomotives

FIREMEN on big locomotives find promise of lightened work in the rotatable coal hopper that has been invented for engine tenders. This invention is so planned that the coal is kept handy at the firing deck, making it an easy matter for the firemen to reach the coal without shoveling from the rear of the tender or using power apparatus. This special hopper is in the form of a great segmental tub, or drum, having a diameter that is the approximate width of the tender. This drum is inclined toward the firing deck; it is so mounted on a ball-bearing center plate as to turn readily. In its outer wall are openings, one for each segment, through which the coal falls by gravity. As soon as the coal is emptied from the segment, the brake that controls the drum is released. Naturally the greater weight above the center of the drum makes it rotate, bringing the next loaded segment into position.

Hunting the Dinosaur Fossils

ALBERTA was the home of many terrible reptiles and mammals now known only by polysyllabic names according to W. E. Cutler, who is excavating in the Red Deer valley for prehistoric remains. He has been digging up the skeleton of a Ceratopsian (Horned Dinosaur), and has located the whole of one side and the skull. He has also obtained a fine skull of the Stereocephalus Tetus (the Armored Dinosaur), with massive plates of bone imbedded in the skin, some of the plates being an inch in thickness. Recently too he found the fossilized skeleton of a Hadrosaur or duck-billed dinosaur.

Two dinosaur beds are located in Alberta, the Edmonton beds of the later period on the Upper Red Deer River near Drumheller, the coal town, and the Belly River beds commencing at Steveville and extending twenty miles downstream on the Red Deer. The species—although a few are common to both beds—are separated by a layer of 800 feet of marine deposits which contain remains of marine creatures.

In those early days figs grew in Alberta but the land area in western Canada was small, a central ocean dividing the solid earth from the Peace River to Central America with a coast line near Field and Banff and high mountainous country to the west. Mr. Cutler believes that the silt in which the prehistoric monsters' remains are found came from this mountainous district.

He reports that it is becoming increasingly difficult to get good specimens and he advises Alberta to get some and store them until it has the proper facilities to display them. At the same time he thinks it would be a mistake to place an embargo on the export of specimens by Barnum Brown and other American explorers.

Zinc Manganese Alloy

IT is claimed that a satisfactory substitute for copper, bronze, and brass has been devised by adding not more than four per cent of manganese to zinc. The resulting metal is claimed to be about twice as hard as zinc and to have far greater resistance to impact. It is said to be possible to forge the new alloy when warm and also to stamp and roll it.

Research Scores

A LARGE body of ore discovered during development work in search of gold-bearing material was found to yield about $3 worth of gold and silver per ton, which, notwithstanding a low cost for concentration, was entirely unattractive. The problem was put before a group of research men who have found that besides recovering the precious metals the material can be made to yield per ton $20 worth of white sulfur and another $20 worth of paint pigment, for both of which products there is an active demand within a reasonable freight distance. The cost of the entire operation is such that more than $35 net per ton can be realized from a material that a few years ago would have been discarded as not worth working.

Sound Records

A PROCESS for producing sound records has been patented in which a fine modeling clay is substituted for the usual wax base materials employed for recording sounds. When the record is made the clay is dried so that the exact character of impression made by the recording needle is retained. The disk is then fired in a pottery kiln and a metal matrix from which records for sale are made in the usual manner, is prepared from this pottery disk. It is also claimed that plaster of Paris or other cement just about to set may be employed.

Japan as a Buyer of Copper

ONE of the surprises of the year just past has been the rôle played by the Japanese in the American copper market. On every recession in values, buying by such interests has been an important factor and comment as to the object behind it has been general. The magnitude of this annual movement may be appreciated by the fact that last September the copper exports to Japan were nearly 60 times what they were in the ten years ended with December 31, 1918, while for the ten months ended with October, 1919, Japan is credited with 63,100,000 pounds or over 140 times as much as for the ten-year period referred to. Japanese buying of zinc, while not so striking as in copper, has also been heavy.

In other years Japan has exported about half of her own copper output. It is therefore surprising that she should have made such a complete reversal of policy. This may be partly explained by the statement that Japan's production of copper has decreased and her consumption increased. But there is something more than this.

Japanese manufacturers and laborers have learned how to produce in mass and the country has undoubtedly started on an era of great industrial expansion. One view of the situation is that because Japan had a thorough training in munition work, this expansion is making its first appearance in brass making. Japanese merchants are said to have discovered that Germany had prior to the war an extensive export trade to the Far East and to South America. To capture this may be one explanation of the recent buying of copper.

Whether or not, as not a few think, this heavy buying of metals and other materials portend the existence of a Germany of the Far East, it is certain that it means that Japan with her cheap labor and great imitative power, will be or already is a most important factor in the world's international trade.

A Marsupial Rhinoceros

AS the result of an examination of a nearly complete skeleton of the extinct marsupial Nototherium Mitchelli, hitherto known only from fragmentary remains, found near Smithton (Tasmania) this year, Messrs. H. H. Scott and Clive Lord have come to the conclusion that the Nototherium was a marsupial rhinoceros. The structure and shape of the horn are matters for conjecture as no remains of it have been found but the specially constructed cervical vertebrae, the structure of the nasal regions and the curious nasal cartilage—all point to the conclusion that the animal possessed a rhinoceros-like horn. If so it is a curious case of parallel evolution for the true rhinoceros belongs to a different and "higher" group than the marsupials, none of which at the present day possesses anything remotely resembling horns, nasal or otherwise.

Tuna Fish Oil

ACCORDING to a circular issued by the Paint Manufacturers Association excellent results have been obtained with tuna fish oil indicating that this product can be utilized, in whatever quantity produced, by the paint industry. Comparative drying tests have shown that tuna fish oil dries more rapidly than most grades of raw linseed oil. The gravity, iodine number and saponification value of the oil are similar to the constants of linseed oil, while the high iodine value, 184, is of unusual interest since it is actually higher than that of most linseed oils.

Yellow tail fish oil is another product supplied by the Bureau of Fisheries for these tests. It gives results almost as satisfactory as linseed oil.

Improvement in Cement Manufacture

A UNITED STATES patent has been granted covering what is claimed to be an improvement in the wet process for manufacturing Portland cement. It frequently happens that the slurry sets to such an extent as to prevent its efficient handling in the usual apparatus. The object of the invention is to provide a setting preventive which will facilitate the use of the wet process and subsequently be destroyed in the kiln. One quarter of one per cent of sugar has been found satisfactory, since it prevents setting in the slurry and is of course eliminated during the clinker operation. Molasses, oxyacids, oxy-aldehydes, and oxy-ketones are examples of other suitable materials.

American Potash

IT may be well to again remind those who have looked forward to the purchase of cheap German materials that times have changed throughout the world. German potash is now being quoted to the German farmer at from $2.70 to $3 per unit for the same material which formerly was sold to the American farmer, transportation paid, at 60 cents per unit wholesale. Now, on this basis the American bill for German potash used in agriculture, calculated on the imports of ten years ago, would be 75 millions in place of 15 millions as formerly.

In view of these facts, we should be very slow in discarding the beginnings that have been made toward supplying potash to American farmers from American sources. As it is now, the American industry has been discouraged and under the conditions prevailing abroad we can expect little from the old sources for some time to come. The situation as it now is was outlined by J. W. Turrentine during the recent meeting of the American Chemical Society.

Raising a Train Shed

THE Delaware, Lackawanna & Western Railroad has nearly completed a project of raising to its original level its Hoboken, N. J., station train shed, the supporting columns of which had sunk irregularly from 5 to as much as 14 or 17 inches in places. This shed is the first ever built of the Bush type with slots for the locomotive smoke stacks. It is 360 feet wide and 630 feet long, covers 14 tracks and an area of about 5 acres and weighs 18,000,000 pounds. It is supported on 207 cast steel columns each set on a concrete foundation resting on 80-foot wooden piles which had settled. The shed was raised in 4 sections by means of jacks at each column in the station to bring the roof to its proper level. The concrete platforms have also been built up and the tracks raised to their original level. The old scheme of wire-glass roofing with large sections of glass which used to break from the vibration has been replaced by a concrete and vault light roofing. The whole project has been carried out without delay to a traffic of 225 trains daily or without inconvenience to the 1,500,000 passengers who use the station monthly.

Making silicate grinding wheels

Finishing room where wheels are trued up

The Toolmaker's Tools

The Modern Art of Grinding, and How the Wheels That It Uses are Made

By W. F. Sutherland

WHEN man first learned the art of working bronze and later iron he no doubt cast around for some suitable stone on which to give the finished tool or weapon a keener edge. Later on after the invention of the wheel and axle the fashioning of a gritty stone to a circular shape and its mounting on a circular axle came as a matter of course, but while other mechanical processes have undergone continual change and betterment the art of grinding has remained, until a few short years ago, much the same throughout the ages.

Today precision grinding is perhaps the most important machine shop process, for without it the automobile, the airplane engine and countless other standardized mechanisms would be impossible. Together with the accuracy possible with the modern grinding machine goes the usefulness in general of the abrasive wheel for rougher operations and in the combination of these two functions is found an instrument, without which modern industry would almost cease to function.

This is all the more remarkable since it can be safely said that modern grinding practice is hardly more than twenty-five years old. The modern abrasive wheel has kept pace with the development of grinding machinery and the increasing number of fields in which grinding finds a high degree of usefulness. The development of artificial abrasives and the care now used in incorporating them into the finished wheel have given the user a wide range of wheels with which he can grind anything from rubber to the hardest steel.

Aside from the natural grit stones found in every part of the world, emery has perhaps been in use for the longest time. Emery occurs as a granular or massive dark colored rock having much the same appearance as iron ore. It is usually associated with the oxides of iron and in addition to these sometimes contains quartz, mica, tourmaline, etc. Indeed emery may be regarded as a rock rather than a definite mineral species.

The chief sources of emery are found in the old world, the island of Naxos having important deposits which have been worked from a remote period. Turkey contains large deposits and the island of Madagascar also has some emery. Emery is also found in several localities in the United States.

Emery is only a very impure form of corundum, a mineral composed of alumina (Al_2O_3) and which forms in some of its finer varieties valuable gem stones. The finely colored transparent varieties include such varieties as the ruby and sapphire, while the impurer and granular forms are known as emery. The term corundum is now more or less restricted to the remaining varieties which while they have a crystalline structure are not of value for ornamental purposes through their poor appearance.

It is these latter varieties which make a valuable abrasive and corundum, under various trade names, forms the basic material of one large branch of abrasive wheel manufacture. The corundum used is either mined or produced artificially in the electric furnace, the latter becoming more and more the source of supply.

The largest deposits of natural corundum as distinct from emery are found in the province of Ontario. Three distinct outcrops have been observed, one of them being about 103 miles long by about 6 miles wide at its widest point. The corundum is found scattered through the rock in the form of six-sided prisms, sometimes of considerable size.

While alumina is generally conceded to be the third most important constituent of the earth's crust, being only outclassed by silica and oxygen, its occurrence in crystalline form is not so widespread as one might suppose. Corundum however is by no means a rare mineral, recent explorations and examinations having revealed important areas of corundum-bearing rocks throughout the world.

It is generally conceded that man cannot equal Nature's handiwork in many particulars, such as painting the lily, but while this is true it is given to him to rival her in other respects. Such is the case when it comes to abrasives, and not only is it possible to produce artificially a corundum having more desirable properties than the natural but it is also possible to produce another abrasive of an entirely different nature not found anywhere in a natural state. This latter product is carborundum, a compound of carbon and silicon. Both the artificial corundum and carborundum are produced by the same means in the electric furnace.

In the making of artificial corundum, bauxite ore is used, the same substance from which aluminum is won, but of slightly lower alumina content. In appearance not unlike ordinary clay, it differs from it in the much higher content of alumina present, that used for abrasive manufacture having a representative analysis of about as follows: alumina, 55 per cent; silica, 8 per cent; ferric oxide, 4 per cent; and titanium oxide, 1½ per cent. The bauxite used in the manufacture of abrasives at Niagara Falls is obtained in Georgia, Alabama, Arkansas and Tennessee. Large deposits are also found in France and British Guiana.

The major portion of the bauxite used in American industries comes from Little Rock, Arkansas, where open pit mining is carried on and steam shovels load the material into cars for transportation or calcining. As bauxite contains combined water, this has to be driven off before it can be used for aluminum or abrasive manufacture. The aluminum companies calcine the ore before shipment while it is the practice of the other companies to calcine at the furnace plant.

All the companies manufacturing aluminous abrasives have their furnace plants located within a few miles of Niagara Falls on either the Canadian or American side. Cheap power in large quantities is a necessity for electrothermic work and the advantage of the Niagara District in this respect is clearly shown by the number and variety of the industries located there.

While the use of the electric furnace in the production of corundum is necessitated primarily to crystallize the alumina, it also performs certain other functions and enables chemical reactions to be carried on which free the raw material from the silica and other impurities present.

It will be noticed from the analysis given above that considerable silica with some iron and titanium oxides are present in the crude bauxite. Since the product desired is crystalline alumina, these must be removed and for this purpose coke and iron borings are added to the calcined bauxite before it is furnaced. In the reactions which take place, the silica, together with any iron and titanium oxides which are present, is reduced and forms an alloy with the iron which has been added. The result is ferro-silicon of about 11 to 20 per cent grade and this is a valuable by-product, especially so during the period of the war.

Pit-type furnaces are used as will be seen from the accompanying illustrations. The furnace consists of a refractory bottom and the four side walls of brick, mounted on a steel truck. These sides never come into contact with the molten alumina, as it is so refractory that it forms its own furnace lining. The carbon electrodes hung on supporting gear are moved up and down automatically by electric control in such a manner as to keep the current which flows through them and the bath at a proper value.

The charge is fed in gradually and at the end of about 30 hours' operation the furnace is full of an intensely hot fluid mass. The alumina floats on top while

(Continued on page 312)

The kilns in which vitrified wheels are fired

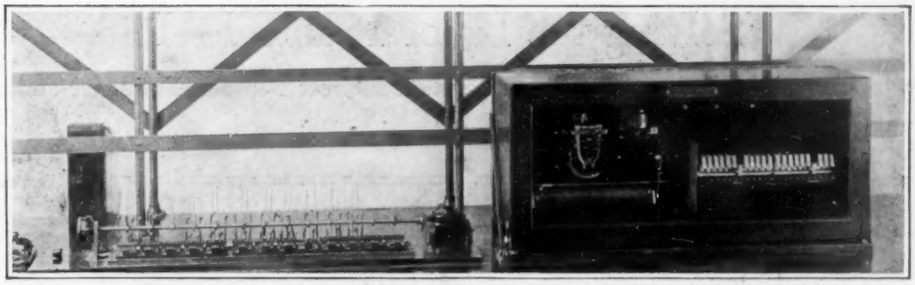
Gas Control by Machine

AN extremely sensitive apparatus for the automatic control of the nitrate plant at Muscle Shoals, Alabama, has been developed by the Bureau of Standards. The principle of operation is radically different from the workings of former mechanisms designed for similar uses, inasmuch as a single unit has never before been applied to so wide a variety of gas mixtures.

The device has the capacity of recording twelve different analyses successively at intervals of one minute, repeating the cycle automatically. It can determine the analysis of carbon monoxide, hydrogen, nitrogen, carbon dioxide, ammonia and various other gas mixtures. Seven different combinations can be unlocked by this apparatus, including interpretation of flue gases, mine oil, blast-furnace gases, and many industrial gases.

The operation of the instrument depends upon the conductivity of heat through the gases. The wires stretched in the axis of tubes placed in the thermostat are heated electrically. The temperature contained by such a wire depends upon the heat conductivity of the gas, which varies with the composition of the gas. By comparing the electrical resistance of two such wires, exposed to different gases, the composition of several classes of gas mixtures can be revealed. This comparison is made automatically by means of the recording wheatstone bridge shown at the right of the photograph.

The unwieldy frame shown in the accompanying illustration is not essentially a part of the automatic gas analysis apparatus itself, the framework being originally planned to support some auxiliary equipment which is not an integral part of the particular machine being discussed. The outfit can be conveyed from one part of the laboratory to another by a single individual. Similar mechanisms are to be installed in the helium plants at Petrolia, Texas, and at the hydrogen plant, Langley Field, Virginia.



The wires shown at the left, together with the recording device at the right, analyze and record twelve different gases at intervals of one minute without attention

How Uncle Sam Liquefies Hydrogen and Then Bottles It

IF the seemingly extravagant claim of an Italian scientist, that one gallon of liquid hydrogen is sufficient to propel an automobile for 250 miles is borne out in practice, hydrogen liquefiers may become of common usage in the not remote future. As it is, however, the Low Temperature Section of the National Bureau of Standards has designed and installed the first hydrogen liquefier in service in the United States.

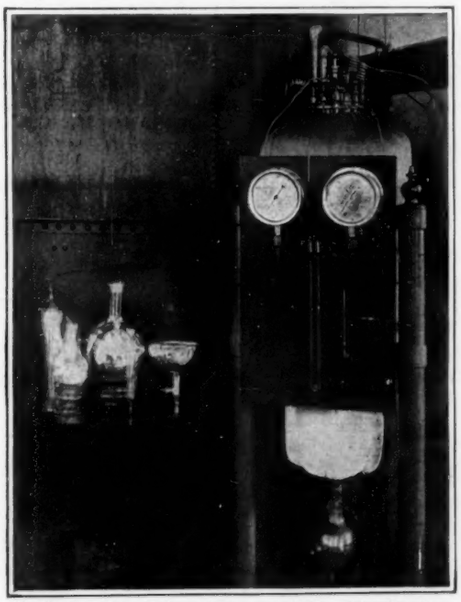
The apparatus, shown at the right in the foreground of the accompanying illustration, admits hydrogen at a pressure up to 2,500 pounds to the square inch. First, it is cooled by liquid air at atmospheric pressure, say, a temperature of approximately 190 degrees Centigrade; then by liquid air at reduced pressure, which produces a lower temperature, and ultimately by its own expansion through a valve. According to this fashion, the boiling point (252.6 degrees Centigrade) is obtained, a portion of the hydrogen is transformed into a liquid state, and is collected in the Dewar vessel located at the bottom of the liquefier.

The cold hydrogen, not converted into a liquid, serves the purpose of cooling the incoming compressed gas, and then returning to the gas holder. Liquid air used for this purpose is produced by the expansion of compressed air within the same apparatus. Solid hydrogen is manufactured by cooling liquid hydrogen, being evaporated under reduced pressure.

Situated on a stand at the left in the photograph is a group of Dewar vessels for holding liquefied gases. The glass containers have two or more walls with the space between highly evacuated as a way of minimizing air conduction, and are usually silvered to diminish the transfer of heat by radiation. The apparatus, in toto, lends speculative interest to the announced discovery of the chemist in Italy, who claims to have found a method of cheaply producing liquid hydrogen.

Improvements in Cast Iron Wheels

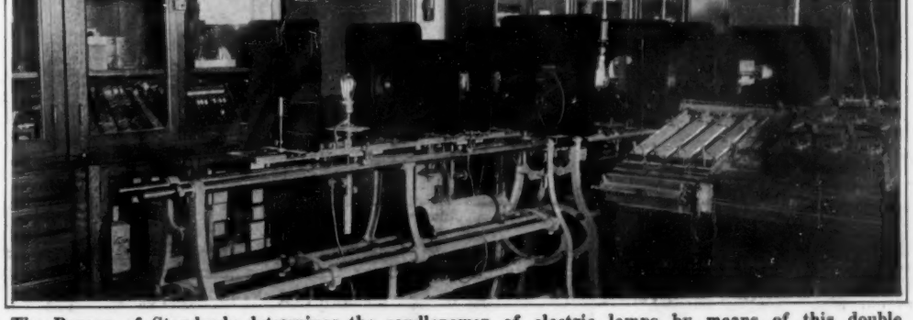
FOR the railroad-material industry, the Bureau of Standards has worked out a number of important problems. It has completed an investigation of the graphitization of white cast iron upon annealing. This problem arose in connection with other investigations of the properties and characteristics of chilled-iron car wheels and in particular the best range of annealing temperatures. This was brought to the attention of the Bureau by one of the car-wheel manufacturers. The



Hydrogen liquefying device at right and collection of Dewar containers at the left

composition is so chosen and the wheel is so cast that the tread and inside of the flange show white iron and the remainder graphitized or gray iron. In order to relieve the stresses set up during the cooling of the wheel under drastic conditions, the wheels are piled in pits while red hot and allowed to cool very slowly. Investigation developed that the highest temperature at which no graphitization of the tread and flanges takes place is about 700 degrees Centigrade, which is also the maximum annealing temperature for car wheels.

The investigation of stresses in chilled-iron car wheels caused by heat from brake action has been nearly completed, says the Bureau report. A very large percentage of car-wheel failures are attributed to stresses caused by heating of the tread by brake action, the central part or hub of the wheel remaining relatively cool. It is the purpose of the investigation to determine and record for adoption the most suitable material and design of wheels to resist stresses of this kind. In this investigation the tread of the wheel is heated by passing an electric current through a circular resistor insulated from the tread. The wheel remains stationary, thus readily permitting the taking of the temperature and strain-gage readings. Considerable differences have been found in the behavior of wheels differing in design and weight.



The Bureau of Standards determines the candlepower of electric lamps by means of this double precision photometer

Technical Sponges

A SPONGE can be briefly defined as the skeleton of certain aquatic animals—naturally there are a number of varieties. This skeleton while being fairly strong when first used, gradually softens and breaks down through use and bacterial action. A patent for a tanning process has recently been issued to W. H. Allen of Detroit whereby the strength of the sponge is greatly increased and also increased resistance to bacterial action. The sponge is chemically in the same class of material as hides. It is to be inferred there is a good fortune for the tanned sponge.

Domestic Hot Water by Electricity

A SYSTEM of domestic hot water supply by electricity, introduced by a British electric company, depends on the use of a tank with an electrical heating device which is kept always in circuit. As the consumption of current by each size of tank is known and constant, there is no need for a separate meter, and on the assumption that the electricity supply undertakings will grant a special low rate for the heating current the amount payable can be found by subtracting this known consumption from the total shown by the meter, the residue being charged at the ordinary lighting rate. The smallest sized tank made takes 150 watts (328 units per quarter of 13 weeks), and is designed to give a daily supply of 10 gallons of water at 150 degrees Fahrenheit, which is reckoned to be sufficient for the domestic needs, apart from baths, of a household of five. For baths it is suggested that the bath room tanks should be fitted with a supplementary heater, to be switched on when extra baths are required, the current it consumes being paid for at the lighting rate. The company disputes the statement that electricity cannot be used economically to heat water, as compared with coal, coke, or gas; it asserts that it is true only in the case of small vessels or a pipe system having large surface area in proportion to cubic capacity, and not in the least true in the case of a large cylinder so designed as to have minimum surface area and a continuous operating temperature well below the boiling point.

What Is the Lamp's Candle-power?

THE double precision photometer shown in the accompanying illustration is used by the U. S. Bureau of Standards in keeping check with the international candle as maintained by incandescent lamp standards. The apparatus is the final judge for lamps used by the various Government departments as well as private interests that may apply such standards of quality.

Two observers operate the instrument, the lamp stationed upright in the middle of the apparatus being the basis for applied measurement. Simultaneous observations are taken by the two observers with the test lamps. Electrical instruments and adjusting resistances are shown on the bench at the right of the photograph. Records are stamped electrically on the recording drums, one of which is shown at the center of the illustration.

Solving the Labor Problem—I

The Development of an Industrial Policy of Mutual Interest Between Employer and Employee

By George M. Verity, President, American Rolling Mill Company

WITH all the strikes and other disturbances involving those who own and those who use the means of production, it is evident that we are living in an age of industrial readjustment. At the same time, in spite of the conflict between apparently irreconcilable extremes, it is beginning to look as though we were really making progress toward a definite solution. It is of the greatest importance in such a time as this to have it forcefully brought home to us that adjustment of the contradictory demands of capital and labor is possible, that it does not necessarily involve either sacrifice of the general outlines of the present capitalistic system or on the other hand a continuation of the unreasoned subservience of labor's interests to capital's whims—in short, that at the present time and in many places a middle ground has been found and a process worked out whereby capital and labor can really work side by side in harmony and good understanding. The SCIENTIFIC AMERICAN, *in order to contribute to the circulation of this idea, has asked high executives, in plants where cordial relations between the owners and the workers prevail, to write their own stories of how these relations have been brought about. Mr. Verity's story is the first of a series which will include articles by numerous other gentlemen of similar standing to his, the general tenor of which will be to show that the two branches of the industrial community really can live in the same house. We think that this series will be found to contain documents of real human interest, and of very material value in the promulgation of right ideas on the industrial situation.*—THE EDITOR.

IN the early days of the steel industry in the United States and leading up to some twenty-five years ago, there seemed to be an almost universal spirit of suspicion and distrust existing between the workers and mill owners. Young men grew up in the belief that the employer could not be trusted and that any holding out of the olive branch was simply camouflage for selfishness or treachery of some kind or other.

It was the policy of the mill owner (there were more individual owners who were operators in those days than now) to hire and fire as he chose and to look on the worker generally as unreliable and untrustworthy. Coöperation in industry had not as yet been born.

That condition existed to a greater or less degree when The American Rolling Mill Company of Middletown, Ohio, began the construction of its works in the spring of 1900. Actual production was begun in the spring of 1901 with a force of some four hundred men composed of both skilled and unskilled men of the various kinds needed in the several departments of the business as then organized.

From the very beginning, the Management was impressed with the idea that real permanent success could only be attained through the hearty coöperation of all those composing the Company's working organization, that the development of the human element was the key to stability and progress. They believed that such coöperation could be secured through,

First: the adoption and the announcement of a "square deal policy," born of real mutual interest and of a desire to be fair, frank and considerate each of the needs and wishes of the other.

Second: through winning the good will and confidence of our men by consistent support of every policy announced.

Third: through visualizing to our organization from month to month the value and soundness of our policies.

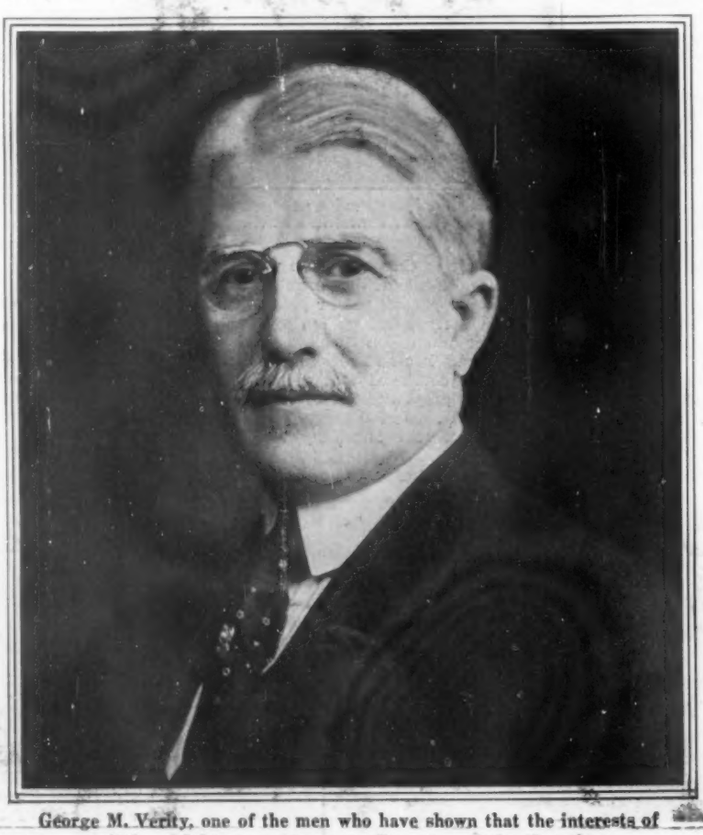
Fourth: through the realization of the fact that a Management must make good to its men just as the men must, individually and collectively, make good to their Company.

Those policies were patiently and consistently supported for a period of five years before we felt that we were entitled to any verdict from our men. At the end of that period we had substantial evidence of appreciation of the policies inaugurated, which gave us courage to make a still greater effort to win the entire confidence of our organization.

An Advisory Committee was appointed by the men in our Sheet Mill Department, which at that time comprised our largest group of workers. Any agreements or suggestions on the part of the men or the Management were put up to them for discussion and consideration. They handled all matters that came before them with such impartiality and fairness that a still closer relation was established between the men and the Management.

At the end of the first ten years, the Company found it necessary to double the capacity of their works and, in so doing, a change from small-mill practice to modern big-mill practice had to be made. This brought in a large influx of new men from all over the country, men who were unfamiliar with our policies and methods of operation. The old organization suddenly became a small part of the new and so it was necessary for us to begin all over again.

While we felt that we had in a very large degree earned the confidence, the good will, and the support of our first group of men, their very belief in the Company was for a time a handicap rather than a help, as the new men felt that they must have been unduly influenced in some manner or other. This new situation, therefore, had to be handled more carefully and wisely than ever as our common interests had become much larger. But a patient, persistent application of our ideas of "a square deal," together with the substantial return that came to the men from month to month and year to year through steady operation without friction or discord, soon had its effect.



George M. Verity, one of the men who have shown that the interests of capital and labor are not necessarily antagonistic; that these two elements can "live in the same house"

As the new men came into the light, they began to see why the older men were friends of their Company and a further lapse of time brought them to a fuller realization of the undisputable fact that the Management and men have much in common and that by working together earnestly, diligently and efficiently more could be accomplished for all concerned than could possibly be secured under any plan of suspicion, discord, and contention.

We endeavored to show our appreciation of the good will and the confidence given us by our working organization by expanding and developing our mutual interest policies whenever and wherever possible, through providing everything we could in the way of incentive, of opportunity for progress, and in the doing of anything and everything that we could that might make life and a place in our organization worth while. "Armco" fosters no welfare work in thought or in deed, for we do not believe in it.

We say to the members of our organization—"Give us your best, your most loyal and efficient service, give us continuous and uninterrupted operation, take that sort of an interest in your individual task as you would if the business were all your own, and in return we will give you the fairest and most generous treatment and the best compensation that the result of our common effort makes possible. We will do anything and everything we can to make life and a place in our organization worth while."

That is what we call "Mutual Interest Work"—a real fifty-fifty contribution with no place or need for anything that smacks of so-called "Welfare Work" or "Philanthropy."

It has always been our conviction that industrial stability is the product of that sort of human happiness and human efficiency that is born of a spirit of confidence and of mutual interest, which is in turn the result of much practical, whole-hearted coöperation brought about by an enlarged understanding of the basic principles underlying all of the problems of a particular business, and of what a real pull-together can do for all concerned.

Wherever human beings are brought together in a common undertaking, there is in the beginning so much of misunderstanding, such a lack of understanding that must be overcome before even a start toward the goal of stability or success can be made.

We believe in that sort of an understanding between associated groups of men that will incite the interest, the imagination, and the ambition of the individual, as that is the only way in which a real group spirit, plant spirit, or company spirit can be created and developed.

Without the influence of a real company spirit, born of mutual interest and understanding, no great accomplishment can be made or perpetuated.

Under our mutual interest policies, there has developed in our organization a strong, constructive, indestructible plant spirit which we term "Armco Spirit" and which has gradually defined itself as follows:

"This spirit is a comprehensive, vital force which finds expression in the practical application of policies builded on a platform of Christian principles, in which selfish purpose has no place.

"This spirit combines in proper proportion a spirit of fairness, a square deal always, both in theory and practice; a big, broad view of every problem, cutting out all narrowness and littleness; a spirit of unselfishness, of loyalty, of

(Continued on page 313)

Taking the Pricks Out of the Prickly Pear

A NEW use has been found for the juicy pear—the prickly variety—and you can well envy the cattle of Texas and other States of the Great Southwest that enjoy such a choice ration. Although this variety of fruit differs from the common pear, its growth being restricted to the desert, it belongs to the big fruit family which name it bears.

Machine used for chopping prickly pears so as to shatter the spines and fit them for stock feed

The prickly pear, as its description implies, is covered with spiny thorns which should be removed before cattle partake of the fruit. An ingenious method of removing the spiny growth, as shown in an accompanying photograph, is to singe the plants with a gasoline torch. The artificial treatment thus burns the tiny thorns and the cows can graze with impunity. Otherwise there is danger of the animal suffering from lodgment of a spine in the throat.

Another method of utilizing this desert plant, which proves a valuable emergency ration during the period of parching aridity, is to put the unsinged prickly pears through a chopper. This merciless treatment which the material receives from passing by rapidly revolving knives is such as to shatter the spines and fits the roughage for stock feed.

The prickly pear, however, is more ideally adapted to grazing—less expense and gives better results when fed in the fresh, green state. Scientists of the U. S. Department of Agriculture, recognizing the value of the prickly pear as a stock feed, has begun experiments in Texas and California looking to its perpetuation under cultural conditions. It will thrive where the rainfall is irregular when staple crops succumb to the drought, and its yields are large and cumulative. There are two classifications of the species—the spineless and spiny varieties, each of which has its respective merits.—By *S. R. Winters.*

Applying the gasoline torch in singeing the spines from the prickly pears, so as to make them available for the cattle of the Southwest

Some Tricks of the Motion-Picture Screen in the Making

IT seems to be quite the accepted thing among film "fans" to expect a favorite actor to climb the fronts of houses and do all manner of other daring feats. Yet if they stopped to analyze some of the "stunts" performed by their screen heroes, they would soon realize that these men could not possibly do the things they apparently do. And here is where we unearth the close alliance between property man and actor especially in comedy productions.

Your hero who climbs up the front of the house can do so in several ways without being a champion climber. In the first place, and where realism is essential, a "front" representing a house can be erected on the studio grounds, provided with ornaments which in reality, are nothing more than staggered rungs of a ladder. These ornaments make it quite a simple matter for the hero to climb or descend the house front.

Then there is another method, with even greater possibilities. That is the "front" that is laid on the studio floor while the cameras "shoot" the scene from above. The hero climbs up the front of the house by crawling on his hands and knees along the studio floor. And the same equipment makes it possible for the "human fly" effect, the dog or horse running up the side of a house, or even the automobile dashing up a wall. The work is quite harmless and simple, to be sure; but so effectively painted is the canvas laid on the floor that it is often a perfect illusion when shown on the screen.

There used to be a certain brand of comedy films which made a great name for itself because of its wonderful action. The audience was held by some bit of clever action every moment of the entire film. The acting was largely in the nature of the so-called "slapstick" comedy, but it was perhaps the highest class of such comedy turned out until that time.

Now the performers of that brand of film did the most startling things. They smashed into walls and went through houses on motorcycles and in automobiles; they ran mile after mile at hair-raising speed; they went through the floor of one apartment and into the rooms below, along with a deluge of lumber and plaster and what not.

In this case the property man's work was apparent at every turn. In the case of those dashes through walls, the studio carpenters merely constructed a suitable scenery on the "lot," which was so arranged as to break away at any fair provocation. Thus the wooden "bricks" were built into a wall, and the various materials were lightly held together. The same applies to those scenes where performers crashed through a floor. The construction in all such scenes was of the "breakaway" or "break-apart" variety, cleverly got up so as to make it seem quite the real thing.

Where a vehicle or a performer is shown dashing along at a high rate of speed, with the scenery flashing behind him, the effect can be secured in two ways. First, the effect may be the real thing, in which case the vehicle or performer is filmed from an automobile or motor truck moving in a parallel direction. Secondly, and most likely, it may be faked in the studio yard by means of a merry-go-round arrangement. This consists of a circular platform with suitable scenery on its inner edge, suitably mounted so that it can be revolved. Now then, with the performer or vehicle placed on the platform and with said platform in action, the vehicle or performer merely has to simulate rapid travel while the stationary camera films the subject which does not move very far from a fixed point in the range of the lens. Meanwhile the scenery flashes by at the rear in a convincing enough manner.

Where an automobile is shown riding along a road for mile after mile, the screen audience obviously traveling along with the vehicle, the effect has been produced by mounting the camera either on the car itself, such as on the hood, or on a platform extending in front of the hood, or on a separate car or motor truck in front. In the latter case the motor truck or car generally tows the automobile where fairly close-up action is to be shown, the hauling cable being hidden from the camera in some suitable manner. By hauling the automobile a definite distance is maintained between the camera and the subject, and there is no danger of a collision.

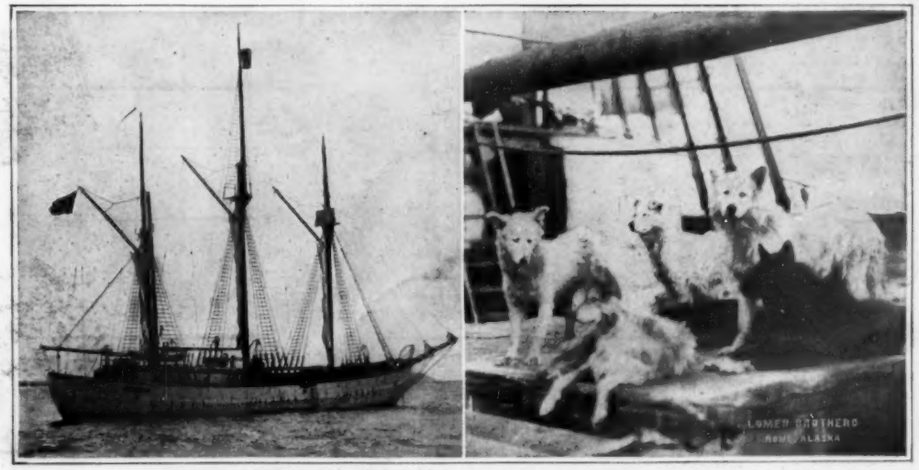
Papier maché bottles, plates, clubs and so on, hinged lamp posts, rubber prison bars—all these things are but a few of the many contributions of the property man to the film comedies. The dishes which the comedians smash on each other's faces with such apparent abandon are certainly of the breakable variety, arranged to smash at the slightest coaxing. Yet a custard pie is always a custard pie: it must be real to produce a reel laugh!

Working the Tar Sands

NINETEEN hundred and twenty acres of tar sand rights in the Province of Alberta have been leased to General William Lindsay. The general claims that, as a result of investigation and research which has been conducted by him and his associates, a successful process has been evolved for the extraction from the tar sands, on a commercial basis, of the oil, bitumen, and other hydro-carbons they contain. The lease has been granted to permit a thorough test of the process.

The Return of Amundsen Expedition

IN connection with the recent arrival of Captain Roald Amundsen in Nome, Alaska, after two years' absence in the Arctic, the accompanying photographs will be of interest. One shows the "Maud," the 900-ton ship which carried the expedition through the polar seas and safely out again. This vessel is specially designed for drifting in the ice packs, having a curious egg-shaped section which makes for its being squeezed up out of the water rather than crushed, when the ice closes in about it. The other view is of the dogs that served the explorer in such good stead in his many expeditions from the ship out over the ice pack.



The ship that carried Amundsen through the Arctic waters, and the dogs that carried him over the ice

Henry M. Leland's own Story of

After the armistice was signed and the Lincoln Motor Co. was completing its contracts with the government for the production of Liberty Aircraft Motors, we called a conference of our engineering force. The principal members of this force are the same men who have been among the leaders in the development of Leland-built cars during the past twenty years.

Henry M. Leland
President

We have always been strong advocates of the conference idea. Nothing of vital importance, particularly to car owners, is left to the judgment of one man, no matter how competent he may be.

"Boys" I said—I still call them boys because most of them were not much more than that when they first came with us some 20 years or more ago. "Boys, you have been telling us of your ideas and we are ready for you to go ahead with them.

"You know our ideas as to quality, ruggedness and stability. You have an opportunity now such as you have never had before, to make a thoroughly roadable car, a car that will not only go anywhere but that will go there with ease to the driver and with comfort to the passengers; a car with which it will not be so necessary to pick out only the good roads, a car that will enable people to travel unfrequented highways and to go places they have not been able comfortably to go heretofore.

"Do the job as you have always been accustomed to doing, only do it better. After the experimental cars are finished, we want to figure on at least a year to prove them out, so as to leave no shortcoming for the car owner to discover."

In about six months they had designed several different types and had actually constructed two different types. They were both truly wonderful cars, but we adopted the better of the two. Four engines were built; three of them were installed in chasses and the fourth was assigned for testing on the dynamometer. That was about a year ago.

Then followed the refining process and ferreting out deficiencies. The cars have been subjected to the most severe and the most practical punishment we could prescribe and have successfully withstood endurance tests equal to about five years' service in the hands of the average user.

I believe motorists will agree that the ideal car should possess primarily, six important virtues—good appearance, trustworthiness, long-life, power, economy and comfort. The order of their importance is largely a matter of individual opinion.

Appearance and Stability

In appearance, the cars are substantial, well-proportioned and graceful. There is nothing extreme or overdone in any of the eight body types—just thoroughly dignified; they are cars such as the best citizens, persons of good judgment and refined taste will be proud to own. Their beauty is a type dictated, not by passing fancy, but by a desire for permanent attractiveness. The cars are replete with those many little conveniences which contribute so much to real pleasure and enjoyment.

Those who are familiar with the accomplishments of our engineers and designers—men who have supervised the building of more than 100,000 quality motor cars—know the unusual reputation of those cars for trustworthiness, stability and long life.

These engineers and designers are still working upon the same principles but with the added advantages of greater resources than ever before, greater precision in manufacture and more suitable metal alloys than heretofore employed.

This in itself would make it reasonable to expect that the new car will possess elements of marked stability—elements which in themselves mean true economy over a period of years. And there is the added assurance that comes from the long proving-out period through which the car has been evolved.

The Engine

Our new engine, which embodies a number of unique and distinctive features, but which cannot well be treated in detail here, I regard as the most efficient piece of motor car mechanism I have ever seen.

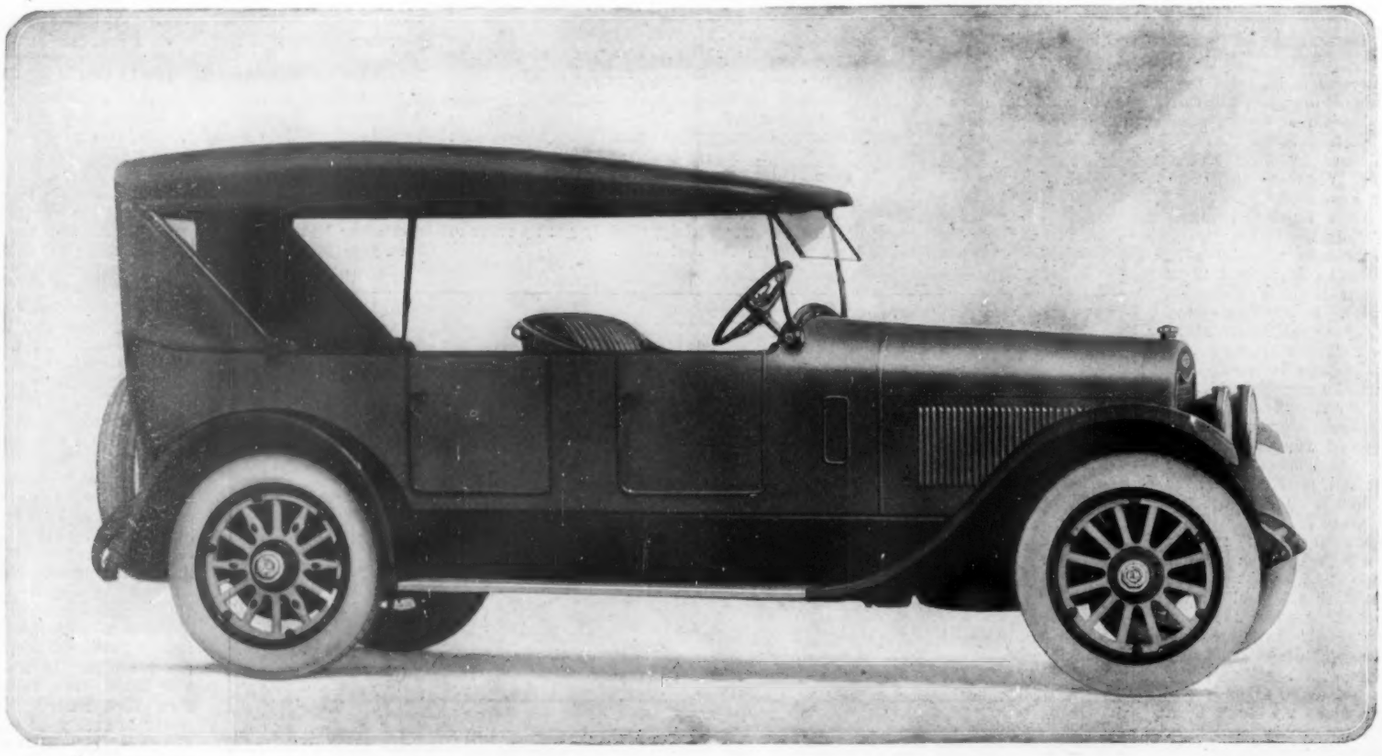
Its piston displacement is 357.8 cubic inches. Its power seems almost limitless; I can hardly conceive of any call to which this engine will not respond.

The wheelbase is 130" except of the Limousine and Town Cars of which it is 136". The tires are 33" x 5" cords.

Comfort and Performance

In this day of fine cars, it is not easy to imagine a more enchanting way of abridging distance, but let me cite my own experience:—

Our engineers and experimental drivers had been telling us what an unusual car they had; but



The Seven-Passenger Touring Car

(Leland-built Lincoln Cars will

the new Leland-built Lincoln Car

frankly, I was a little inclined to discount their enthusiasm.

However, I had occasion to go to Defiance, Ohio, some 125 miles from Detroit—according to the Blue Book. I thought here would be a good opportunity to see for myself just what the car was. There were five of us. The top was up.

We were on a fine stretch with no other vehicles or cross-roads in sight, bowling along serenely at about 40 miles per hour—*so I judged.*

I am constitutionally opposed to speeding, but my interest and curiosity, I suppose it was, got the better of me.

"Step on it and let's see what she can do," I said to Harry, the driver.

"She's doing her best now," he answered.

Doing her best at 40! I was keenly disappointed. My hopes were fast fading when Fred who sat beside the driver called back:—

"Why she's hitting 76 Mr. Leland" and laughingly, "You know this isn't an airplane with a Lincoln Liberty motor."

Perhaps I should have known better had I observed how swiftly the scenery was passing.

My hopes rose. There that car was running just as sweetly and with as little fuss and vibration and with as little apparent effort at 76 as it did at 30—and there was none you could notice at 30.

Periodic vibration, which is something that engineers have tried for years to overcome, was at last absolutely unapparent to me, *at any speed.* There seemed to be an unusual harmonizing of the various functions. And the car was so steady; it seemed to hold the road as if it were in a groove.

I might add in passing that this elimination of the vibration period was not an accidental accomplishment. On the contrary, it was achieved only after much research, experimentation and money outlay.

Elimination of engine vibration, practically to the zero point, is without question a great stride toward prolonging the life not only of the engine itself but of the entire car.

As I said before, I am opposed to speeding; but when a car is made to possess the many other essentials to a real performer—power, acceleration, facile control, etc., speed is a natural consequence. You might call it a by-product, the use of which is entirely at the option of the driver.

A little further on the trip, we came to another stretch; it was pretty rough; several miles of what you might call de-macadamized road. It was a stretch that ordinarily you would not want to take faster than at about 15 miles per hour; but at 41 we were not uncomfortable. The sensation was more like sailing in a yacht as compared to a canoe on a choppy surface.

There was a most agreeable absence of sidesway and violent bouncing—no tendency to throw the passengers up and about.

From a standstill, the car seemed to get away with the grace and ease, but with the swiftness of a thrush, rather than with the flutter of a partridge.

I believe I have ridden in or on almost every kind of conveyance, from the ox-cart to the airplane, but even with all my fond hopes and anticipations, never did I expect to ride in anything which comes so near to what I imagine would be the sensation of flying through space without mechanical means.

The prices are based upon the highest class of materials and workmanship, and upon scientific and economical manufacturing methods, made possible by tremendous preparation in labor-saving machinery, tools and devices—plus knowing how to use them.

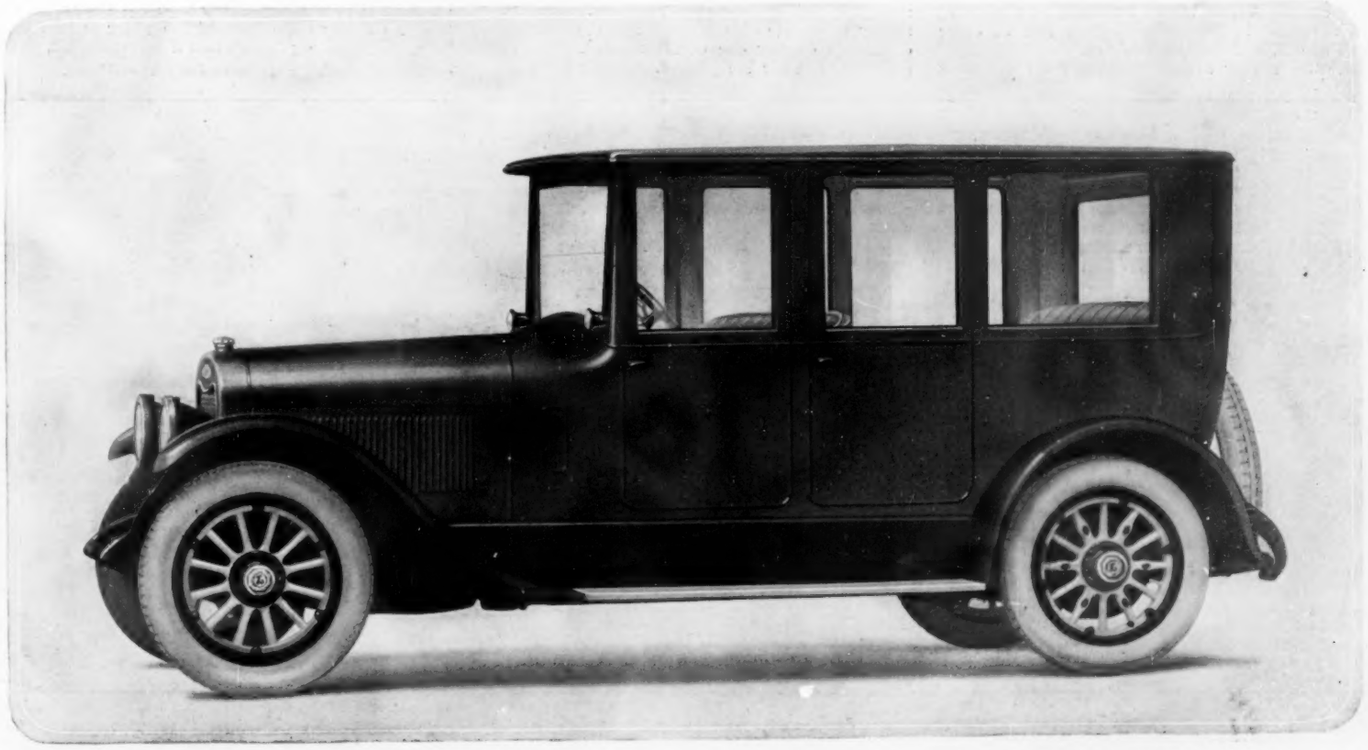
While these involve a vast initial expenditure of time and capital, they lend themselves to minimum production cost in large volume. There will be a legitimate margin of profit—no more. There will be nothing added just because we anticipate that motordom will recognize a superior car, nor because we anticipate that the car will afford a degree of satisfaction and comfort heretofore unknown.

Wilfred C. Leland
Vice-Pres. and Gen. Mgr.

We are obliged to send this story to the publishers some weeks in advance of its appearance. It is expected that cars will be in the hands of Distributors by the date of this publication. Should something unavoidable occur, there may be a little delay in deliveries, but we can foresee nothing now.

I have tried not to be over-enthusiastic but the car *really is* such an innovation that it is not easy to exercise restraint, and I feel confident that your own observations of the car and its performance will abundantly confirm my own impressions.

Henry M. Leland
President Lincoln Motor Co.
Detroit, Mich.



The Five-Passenger Sedan

be available in eight body types)

Reconstructing Stonehenge

Work of Preservation That May Solve the Origin of Britain's Most Mysterious Ruin

By Harold J. Shepstone, F.R.G.S.

STONEHENGE, Britain's oldest and most mysterious ruin, is in the hands of the builders. Powerful cranes and the latest modern lifting appliances have invaded its sacred precincts and gradually the work of restoring the monument to something of its former grandeur is being carried out.

It was just before the armistice that the strange conglomeration of stones which adorn one of the ridges on Salisbury Plain passed to the nation, and now belongs to the British people. The restoration work is being carried out by the Office of Works, under the direction of Sir Frank Baines, a well-known architect. He is being assisted in the task by the British Society of Antiquarians, who are hoping as a result of the excavations which are being made on the site to learn something of the origin of this strange pile of stones. That has always been the riddle of Stonehenge. Who built it? When was it reared? And for what purpose was it conceived?

General view of the operations at Stonehenge

Although no one has satisfactorily answered these questions it is nevertheless possible to tell how it originally appeared, despite the fact that many of the stones have fallen, while not a few have entirely disappeared. Some of the smaller ones have been carted away by unscrupulous persons and used in the building of local bridges and other structures. Others again have been broken, and will require special treatment if they are to be used again.

One cannot view the remains of Stonehenge today without marveling at the ingenuity of those early Britons. When it is remembered that it was probably built between 3,500 and 4,000 years ago, that some of the stones turn the scale at 30 and 40 tons apiece, it is clear that it represented in its age a great and momentous undertaking. It is a complicated structure of earthworks, of stones arranged in circles, of stones arranged in horseshoe fashion, and of other isolated stones, and earthen barrows.

First came a long avenue, running from northeast to southwest, defended by ditches on both sides. This leads to a circular earthwork about a hundred yards across. Within this stands the real Stonehenge. First came an outer circle of what archaeologists technically call trilithons; that is, two stones planted upright, side by side like two posts of a door, with a third placed across in the fashion of a lintel. There were thirty of these piers in all, and with their imposts they formed a corona or ring of stones at a height of about sixteen feet from the ground. Within this outer wall, and almost forming a lining to it, stands a smaller circle of stones of which only a few remain. Within these two circles again come two horse-shoe erections in the form of huge trilithons.

Besides these regular structures there are scattered remains. A single stone, called the Sun Stone, lies in the avenue and on the axis of the horse-shoe. It has been so christened because it stands just where any one inside the horse-shoe would see the morning sun at mid-summer appear above the horizon. On it the first rays of the sun would fall, and therefore it is the Sun Stone. Inside the circle two large stones lie prone, respectively called the Alter and the Slaughter Stones.

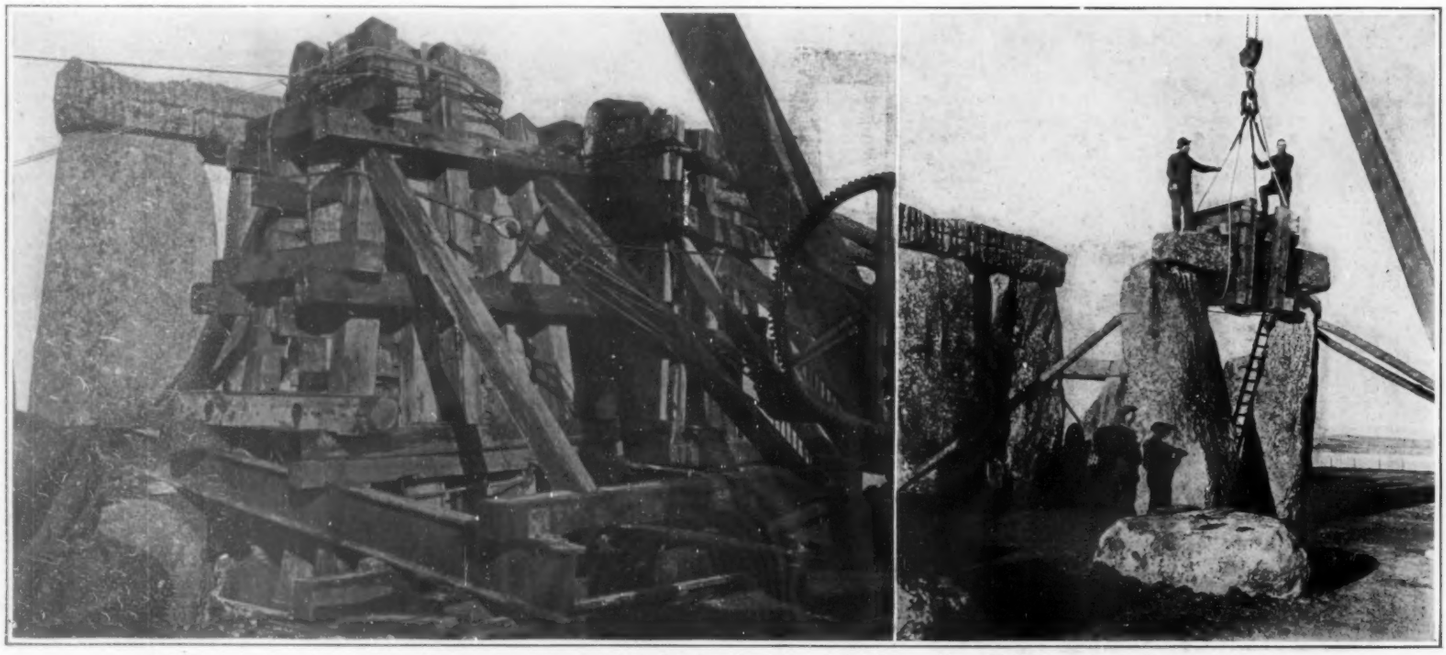
The work of restoration is being carried out in a most thorough and systematic manner. First a minute survey was made of each stone and the smallest crack or crevice on any one of them noted. These cracks are being left for the present. They will be attended to later, the question of the moment being how to save the stones without doing anything to spoil or alter their looks. After the survey the stones were numbered, a powerful crane erected, and the work of actual reconstruction put in hand.

Attention was first paid to one of the trilithons whose pillars were leaning at a dangerous angle. The lintel, the impost across the top which turned the scale at five tons, was first carefully enclosed in timber baulks and thick layers of felt so that it would not be damaged in any way. It was then lifted by the crane and lowered carefully to the ground. In order that the two pillars should not be damaged they, like the lintel, were protected by timber baulks and felt. Never was the most precious of babies more carefully wrapped up than is one of the monoliths before the jacks which force it into its rightful position are set to work. Not only is it cradled in thick baulks of timber, but every cranny is filled up and padded with felt and wedges and the whole framework is again supported by struts and steel joists.

It is necessary now to lay bare the base and make a new bed for the monolith. The ground round the pillar is outlined into squares of twelve inches. Inside these squares the earth is taken out to a depth of six inches at a time and passed through a sieve. The object here is to salve any object which would throw light upon the actual origin of the monument. A Roman coin, numerous stone implements, and wooden stakes driven into the earth for the purpose, presumably, of keeping the stones upright, have been excavated. It has been found that these huge pillars which stand 21 feet above the ground and weigh between 30 and 40 tons apiece were usually set in the earth to a depth of only three or four feet. With such crude foundations it is wonderful how well the stones have stood.

As soon as the base of the pillar is laid bare the work of moving it back into a perpendicular position is

(Continued on page 314)

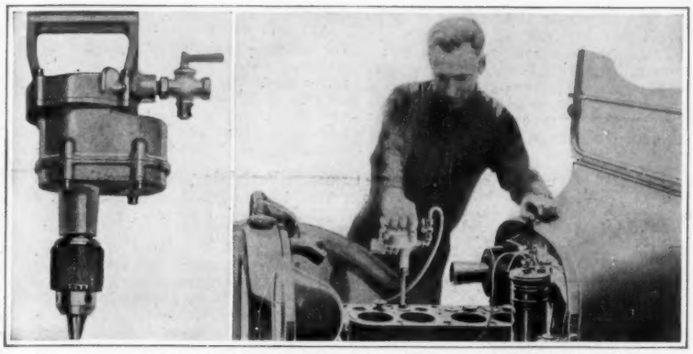


Left: Ready for concreting the base. The monolith, still encased in lumber, has already been jacked into position. *Right:* Preparing to lift one of the lintels.

Some details of the work being undertaken on the Stonehenge monuments

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Two pneumatic tools for garage work: The pneumatic drill and the pneumatic valve-grinder

Putting Air Pressure to Work in the Garage

TWO interesting devices which can be operated on the ordinary garage air tank have been perfected by a Michigan manufacturer. A pneumatic drill weighing 7¼ pounds and a pneumatic valve grinder are the latest developments for the garage mechanic's use.

The drill is capable of being used in close quarters and is particularly serviceable for fender and frame work of all kinds. The device has throttle control permitting proper drilling speeds for various sizes of drills and adaptability to different materials. The motor is of the turbine type and the entire mechanism is enclosed in a dirt-proof casing.

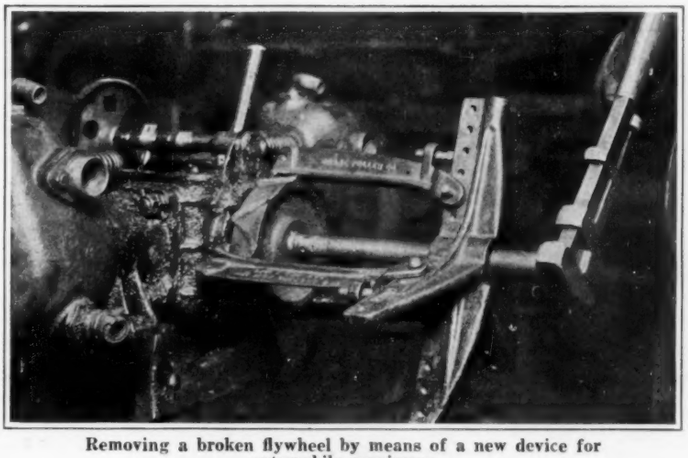
Due to uniform oscillation the valve grinder grinds a more perfect seat than may be obtained by hand drilling. The speed is always under the control of the operator and may be varied from 150 to 1,000 strokes per minute. The grinder is found useful in grinding valves in inaccessible cylinders in various types of motors. All working parts are encased in an aluminum alloy and thus grease, dirt and grinding compound are prevented from getting into the working parts.

When Rusted Parts Must be Pried Apart

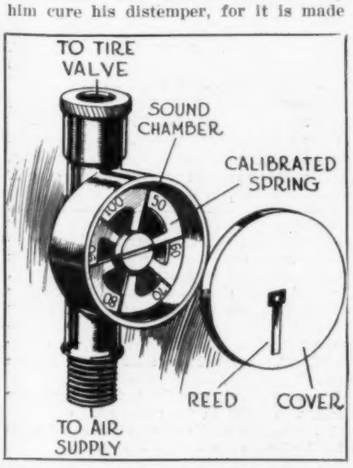
AN automobile mechanic ought to know better than to lose what temper he may have when attempting to remove machine parts which are badly rusted in. This new device will help him cure his distemper, for it is made specially for removing gears, wheels, pulleys, cams, commutators and transmission parts from motors.

A drift and hammer have been used, ordinarily, in removing badly rusted parts, but this method had its dangers and resulted in trouble. The new device is fitted with adjustable arms and locking screws that afford a certain purchase. The pulling screw is of specially treated metal and fitted with a heavy screw point. It is possible to work on the smaller gears and transmissions by adjusting the diameter and using the smaller sized pullers furnished with the outfit.

Special attachments may be used with the puller as well as the adjustable arms. An arbor press attachment is supplied for it which automatically makes the puller available for arbor press work. For bending pipe, straightening shafting and removing universal joint yokes a special pipe bending attachment may be used. For removing solid web flywheels, gears and other similar parts, a stud fork attachment is made use of.



Removing a broken flywheel by means of a new device for automobile repairmen



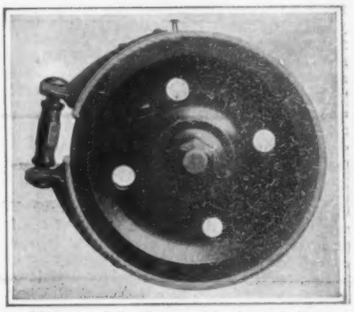
Tire pressure-indicator which whistles when desired pressure is atttained

The Warning Whistle of Tire Over-Inflation

THE latest instance of ingenuity as applied to automobile accessories is the tire pressure-indicator shown in the accompanying drawing. This device consists of a casing connecting the pump connection with the tire valve and having a sounding chamber communicating with the main air passage by a small opening which is closed by a valve. This valve is held upon its seat by a graduated spring, mounted in the sounding chamber, and the cover of the sounding chamber has an opening covered by a harmonic vibrating reed.

In using this device it is first set to the required pressure by removing the cover of the sounding chamber and shifting the graduated spring around its center until the section adjusted for the pressure desired covers the valve and holds it to its seat. After replacing the cover, the indicator is screwed on the valve of the tire and the air supply hose attached. The pump is then started and kept going until the reed in the cover of the indicator sounds the warning that the proper pressure has been reached in the tire.

The action is simple. The spring having been set for a certain pressure, the valve connecting with the main passage will be held upon its seat by the spring as long as the pressure in the tire is less than the predetermined amount. But as soon as the desired pressure is exceeded, the pressure in the main passage will overcome the pressure of the spring, the valve will be lifted from its seat and air will pass into the sounding chamber and will set the reed into vibration, thereby giving the warning sound to the person at the pump.



Universal brake mandrel recently introduced

Simplifying the Relining of Automobile Brakes

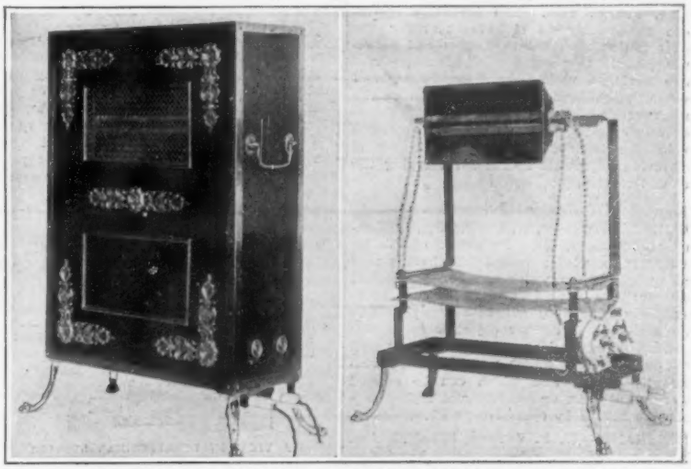
A DEVICE for relining brakes on all cars has been placed on the market by a Detroit manufacturer of automobile accessories. The brake lining and band are firmly clamped on a circular mandrel. The mandrel is turned until the rivet hole in the band comes to an upright position, then a split-rivet is driven in with a hammer blow and the rivet is clinched against the mandrel. This operation is repeated till all the rivets are in place.

Using this device prevents the lining from wrinkling or drawing the lining between the rivets. It is also possible to secure a perfect adjustment of the brakes at the time of replacement.

Something New in Electric Stoves

FROM France comes a new departure in electric stoves, shown in the accompanying illustration. The heating element of this stove consists of a pair of special resistance rods, placed at the focal point of a copper reflector. Resistance elements are placed below the heating elements for the purpose of cutting down the usual lighting current to the proper degree. The entire mechanism fits into an attractive metal case, as shown.

The amount of heat delivered by this stove can be roughly controlled by turning on one or two of the heating rods, this being accomplished by means of the two toggle type switches shown at one side. The construction is exceptionally light.



Two views of a new electric stove developed in France to help solve the fuel problem

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

SHAWL MUFFLER.—L. GARWITT, 5 Pinehurst Ave., New York, N. Y. Among the objects of this invention is to provide a device for ladies which performs the function of a shawl, a muffler and a hood, and which is adapted to be used with the hood in operative position, or folded down on the muffler, and when in the last mentioned position the muffler will be provided with an ornamental collar. The device is especially adapted for use by motorists.

Pertaining to Aeronautics

GUN CAMERA.—E. C. BASS, Avenue Edward, Biarritz, France. The object of the invention is to provide a camera especially designed for use on airplanes employed in training aviation schools to the art of aerial warfare with a view to record imaginary hits by photographs of the adversary. Another object is to permit the aviator to handle the camera similar to a gun and to permit of taking accurate aim.

Electrical Devices

APPARATUS FOR MEASURING OHMIC RESISTANCE OF LIQUIDS AND SOLUTIONS.—T. H. REARDON, 44 W. Main St., North Adams, Mass. This invention relates to an apparatus for measuring ohmic resistance of liquids and solutions; it comprises a vessel of conductive material adapted to contain the liquid, a tube of non-conducting material having one end inserted in the said liquid, and adapted to be filled with the same, conducting material in contact with the liquid at the other and of the tube, an electric circuit connected at one end with the vessel and at its other end with the conducting material in contact with the liquid, and means for measuring the voltage or potential difference of the current in passing through the liquid or solution.

INCANDESCENT LAMP PROTECTING DEVICE.—H. F. WAY, Box 221, Oregon City, Oregon. More especially the invention has to do with what are known as weather-proof type of incandescent lamp sockets used in factories, and its object is to provide means whereby an incandescent lamp utilized with a socket of this type may be rendered inoperative for use with the ordinary type of socket, or with a weather-proof socket unequipped with the invention, the object being to prevent reuse of the lamp in another socket.

Of Interest to Farmers

SEAT FOR AGRICULTURAL IMPLEMENTS.—J. C. BRIAN, 3938 5th St., N. E., Minneapolis, Minn. This invention has for its object to provide auxiliary mechanism for use in seats of agricultural implements for cushioning the seat, to eliminate shock and jar and to diminish to a minimum the disagreeable side motion, the auxiliary mechanism being designed to be arranged upon the usual pressed steel seat of the implement to provide a spring-supported seat.

AGRICULTURAL IMPLEMENT.—J. W. SCOTT, Falcon, Colo. The invention relates more particularly to clod breakers for use in connection with potato diggers and plows. An object is to provide a clod-breaking machine having a positive crushing, rolling and breaking mechanism, resiliently carried on the implement and being power-driven to effectually crush and pulverize earth being plowed up by the implement. A further object is to provide adjustable means for carrying the resilient tension.

Of General Interest

STEPLADDER.—O. W. BROWN, Jr., 12 Kemball St., Sanford, Me. An object of the invention is to provide a stepladder having rear or supporting legs which can be flared apart at their lower ends to give added support to the ladder and which will be securely held in this position. A further object is to provide a collapsible stepladder which is made of steel or other suitable metal which can be conveniently folded, and which can be secured in expanded form to securely and rigidly support the ladder in operative position.

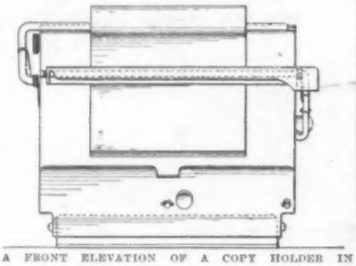
HYDRANT.—W. S. SNYDER, 321 50th Ave. N., Nashville, Tenn. The invention has for its object to provide a hydrant wherein the valve controlling the flow of water is normally spring-closed and is controled to opening position by the action of the hose connection. A further object is to provide a hydrant having drainage and wherein all the parts are protected from freezing, and may be easily removed for repair.

SPONGE RUBBER ARTICLE AND METHOD OF MAKING THE SAME.—J. B. WISHART, 20 N. Westfield St., Trenton, N. J. An object of the invention is to provide a sponge rubber ball or other article of great resiliency. A further object is to provide a method of making sponge rubber articles which results in an article having in its central portion relatively large cells, the cells decreasing in size toward the exterior of the article, and at the exterior the cells being minute so that the surface is practically a smooth continuous one permitting of necessary wear.

PRESSURE BAR MECHANISM.—W. E. MOORE, Janesville, Wis. The invention relates to filling fountain pens having a compressible bag. The object is to provide locking means adapted to engage an interior shoulder in the barrel to normally lock the pressure bar mechanism in position on the barrel but allow free functioning of the same whenever it is desired to fill the fountain pen, and to permit the user to conveniently unlock the mechanism whenever desired.

PRICE MARKING SYSTEM.—H. and L. HOPP, Hopp Press, Inc., 230 W. 17th St., New York, N. Y. This invention relates to numbered cards used for designating prices of articles offered for sale. An object is to provide a simplified price marker system comprising a number of cards with cent marks which are simple and convenient to handle and which may be made up into any price denomination from 1 cent to 99 cents. A further object is to provide a system which embodies very few cards as compared with the usual system.

COPY HOLDER.—A. N. WOODRUFF, 459 Hudson St., New York, N. Y. The invention relates more particularly to copy holders of the movable marker type. An object is to provide a copy holder in which a step-by-step



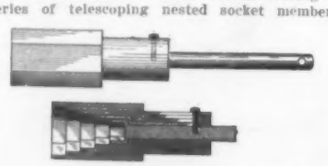
A FRONT ELEVATION OF A COPY HOLDER IN ACCORDANCE WITH THE INVENTION

movement of the marker is obtained by a simple construction, and, at the same time a mechanism of this character which is positive in operation and adaptable to copies having different spaces between the lines, is also provided.

Hardware and Tools

GRINDING TOOL.—P. U. LOVELACE, Clinton, Okla. An object of the invention is to provide a tool which can be manually operated to regrind or true up crank pins or journals on automobiles, engines and the like after they become flat or out of the round. A further object is to provide a tool which can be manufactured at a reasonable price, and conveniently used without the necessity of employing skilled labor.

WRENCH.—S. C. ROSENBERG, First Natl. Bank Bldg., 42 Church St., New Haven, Conn. An object of the invention is to provide a combination socket wrench having a series of telescoping nested socket members



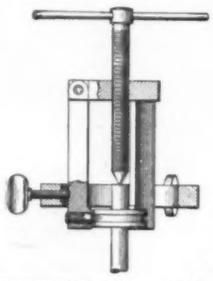
A VIEW IN LONGITUDINAL SECTION

adapted to be quickly adjustable and secured in various longitudinal positions relative to each other so as to present any of the sockets for operation in accordance with the size of the nut or bolt head.

Machines and Mechanical Devices

NEWSPAPER VENDING MACHINE.—O. J. HOTALING, 420 Ogden St., Newark, N. J. Among the objects of this invention is to provide means for ejecting the newspapers singly. Another object is to provide means for preventing the introduction of a coin or check in the machine when it is empty of newspapers. The invention relates particularly to a device of this character covered by U. S. patent No. 1,285,187 issued Nov. 19, 1918.

BEARING PULLER.—F. J. HEINRICH, 204 N. Yakima Ave., Yakima, Wash. The invention especially relates to a device for pulling magneto and small generator bearings. The



A SECTIONAL PLAN VIEW OF THE PULLER

general object is to provide means for engaging the bearing whereby to securely grip the bearing and to be maintained in position against the tendency to slip and disegage under the pressure exerted endwise against the shaft. Also the engaging member is readily renewable if broken.

SPEED OPERATED CIRCUIT CLOSER.—F. E. TOUCHY, 2518 Ave. I, Galveston, Texas. The invention is more particularly intended for use in connection with an alarm on elevators for grain and other foodstuffs in which the belt not infrequently slips or the elevator chokes owing to too much feed, loose buckets, or an obstruction in the head or boot of the elevator, causing loss of time and sometimes producing fires; when such conditions exist a governor will act through the circuit closer to cause an alarm to be sounded.

Musical Devices

CUSHION SUPPORT.—F. W. BOCKING, Rifle, Colo. This invention relates to cushion supports in the form of a resilient pad adapted to receive the feet or casters of any form of musical instrument such as victrolas or pianos and which will absorb the sound vibrations ordinarily transmitted by the instrument to the floor, thus improving the tone and eliminating harsh unpleasant tones caused by contact of the instrument with the floor.

Prime Movers and Their Accessories

VAPORIZER.—M. K. THAYER, Apostol, Wyo. The invention relates generally to internal combustion motors and more particularly to heating means therefor, whose function is to warm up and limber the motor when cold. The object is to provide a simple apparatus of this nature, which will not interfere in any way with the normal operation of the motor and which will be readily accessible and easily perform its intended functions previous to starting.

INTERNAL COMBUSTION ENGINE.—C. C. MANKER, Mayfair Apts., 40 St. James St., Los Angeles, Cal. An object of the invention is to provide a multi-cylinder engine of a relatively light weight, i.e., light in weight compared with the amount of power generated. A further object is to provide an engine having a "wabbler" with opposite pistons on each side thereof, said opposite pistons being connected by straight piston rods which are operatively connected with the wabbler thus obviating the tendency to side thrusts.

AUTOMATIC GAS CONTROLLER.—E. T. OFELDT, Spring Lake, N. J. This invention relates more particularly to automatic means for controlling the feed of gasolene and air to an internal combustion engine in accordance with the speed of the engine. A further object is to provide means which can be attached to any gasolene engine and which operate as an adjunct to manually control the means so that the desired proportion of gasolene and air can be regulated for starting and then automatically regulated after the engine is warmed up.

Railways and Their Accessories

CAR DOOR.—R. A. EDGAR, Carlyle, Kan. The invention relates to doors for railroad cars and has for its object to provide a door of the characters specified especially designed for cars used in hauling local merchandise, or for cars where it is desired to inspect the contents at any time and which may be applied to existing doors without change of the car.

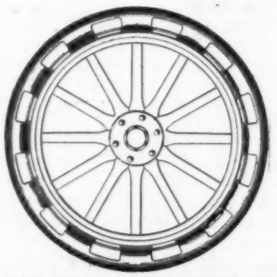
Pertaining to Recreation

TOY BOOK.—M. GOODMAN, 545 W. 164th St., New York, N. Y. Among the objects of the invention is to provide a book or a device having many characteristics of a book, including covers and movable inside members such as leaves having peculiarly arranged legends, figures, cuts and descriptive matter, means being provided in connection with the book to make the inscriptions carried by the leaves legible not only directly but also indirectly by reflection in a mirror, an object being to provide amusement and to familiarize a child with the principals of reflection.

Pertaining to Vehicles

HEADLIGHT DIMMER.—P. P. HEIN, 444 E. 79th St., c/o Bory, New York, N. Y. The invention has particular reference to means to nullify the objectional glare commonly accompanying a powerful light. An object is to provide an attachment for a standard lamp, which may be readily applied, sufficiently far in front of the lamp to provide for an appreciable amount of laterally and rearwardly projecting light for illuminating the roadway at the sides of the vehicle and enabling persons at a distance to recognize the nature of the vehicle, yet sufficient light to meet all requirements being projected ahead.

CUSHION TIRE.—I. N. KEIM, 101 Garden St., Mount Holly, N. J. More particularly the invention has for its object to provide a cushion tire designed to be used in lieu of the pneumatic or inner tube inflated tires,



A FACE VIEW OF WHEEL PROVIDED WITH INVENTION

yet arranged to give the desired resiliency, and to withstand heavy service especially when used on truck wheels. Another object is to securely hold the cushion tire against accidental radial displacement.

Designs

DESIGN FOR A CALENDAR MOUNTING.—A. J. MCDADE, c/o Natl. Calendar Co., 416 N. Y. World Bldg., New York, N. Y.

DESIGN FOR A SPOOL HOLDER.—P. O. MUELLER, 628 Decatur St., Brooklyn, N. Y.

DESIGN FOR A DOLL.—S. P. STARKWEATHER, 2426 Bowditch St., Berkley, Cal. The inventor has been granted two patents of a similar nature.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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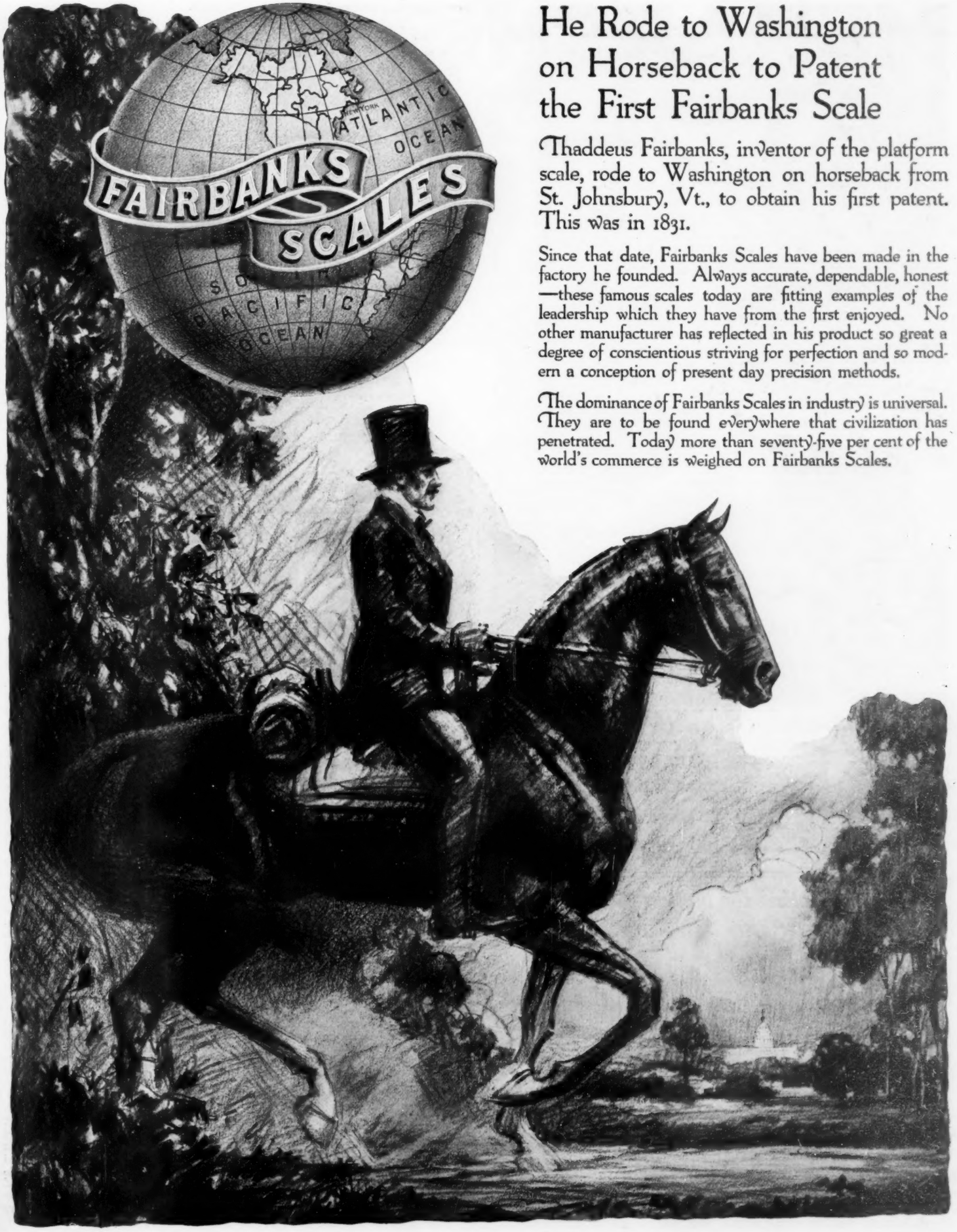

He Rode to Washington on Horseback to Patent the First Fairbanks Scale

Thaddeus Fairbanks, inventor of the platform scale, rode to Washington on horseback from St. Johnsbury, Vt., to obtain his first patent. This was in 1831.

Since that date, Fairbanks Scales have been made in the factory he founded. Always accurate, dependable, honest—these famous scales today are fitting examples of the leadership which they have from the first enjoyed. No other manufacturer has reflected in his product so great a degree of conscientious striving for perfection and so modern a conception of present day precision methods.

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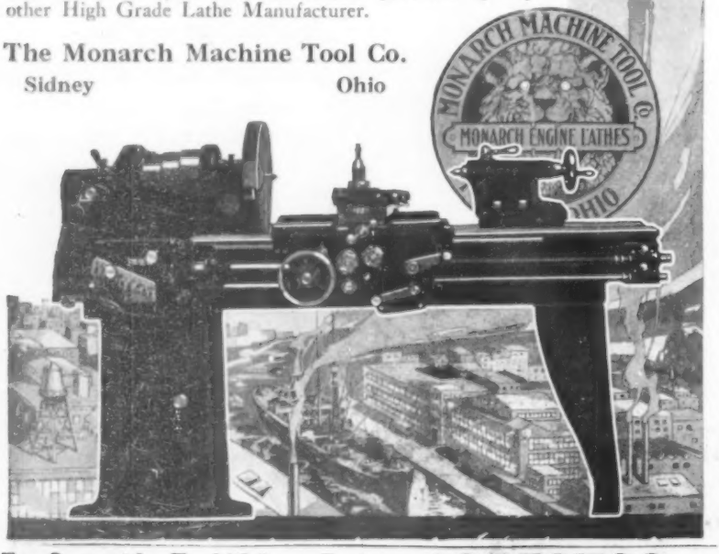

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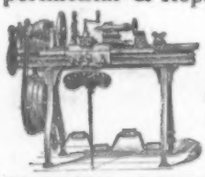

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Behind the Motion-Picture Screen

THE mysteries of the "Movies" are bared at last. It has remained for Austin C. Lescarboura of the Editorial Staff of the Scientific American to undertake the task of answering the thousand-and-one questions constantly being asked by screen "fans" and aspirants to screen careers, in his book entitled, "Behind the Motion-Picture Sreen." Among the subjects covered in his work are:

Scenarios. The Director and His Work. Motion-Picture Acting. Motion Picture Cameras and How They Work. The Cameraman. In the Land of Make Believe. Studios. Mob Stuff. Tricks of the Screen. Laboratory Work. Pictures in Natural Colors. Microscopic Subjects. Talking Pictures. Animated Cartoons and Sculpture. Motion Pictures in Odd Fields. Motion Pictures in the Home and Business. Present Status and the Future of Motion Pictures.

This book has been written in a simple, interesting, and instructive style. It is not technical; yet it covers all phases of the screen art in an accurate and unbiased manner. Pictures? Certainly; this book is the best illustrated book on the subject—over 300 pictures. Indeed, every right-hand page is a picture page; every left hand a corresponding text page. It is something entirely new in book making. "Behind the Motion-Picture Screen" contains 426 pages and over 300 illustrations, printed on the finest coated paper and bound in an attractive cloth cover measuring 6¼ by 9¼ inches. Price, $3.50 net; Postage Extra.

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More Starting Power for the Steam Locomotive

(*Continued from page 295*)

the reverse lever in the corner, and when the locomotive cylinders are getting steam. After steam is admitted to the cylinders the crank-shaft pinion transmits its power through an idler gear to the trailing axle. Hooking up the reverse lever two notches or more automatically disengages the booster and brings it to rest.

The booster puts any locomotive with trailing wheels into the next class above in starting effort, because the trailing wheels act as an additional pair of drivers. On freight trains this means more tons per train because of greater starting effort, and avoids damage to equipment because of a smooth steady start. On passenger trains it means smooth starting and quick acceleration to road speed. This adds to the comfort of the traveling public, protects the equipment from damage, and renders schedules more easily maintained by avoiding delays in starting.

The Disaster to One of Our Latest Submarines

(*Continued from page 298*)

fifteen to twenty feet of the stern of the craft above water. She was brought up to this position by blowing the water from the after trimming and ballast tanks.

The crew now made heroic efforts to cut through the shell of the vessel, which is here about three-eighths of an inch in thickness. Breast drills and ratchet drills were used, aided by cold chisels, hacksaws and a heavy electric drill. Thoroughly soaked to the skin, rendered dizzy by gas fumes, and without any food, the men, in the words of Commander Cooke, "fought like heroes for their freedom and lives." He tells us that when the current was turned on the electric drill, a large part of the power passed through the body of the man operating it, "knotting his muscles, binding his arms to his side and subjecting him to excruciating agony." Finally, by Thursday morning, the crew had cut a small hole, and managed to make the signals already referred to. By wig-wagging this signal they attracted the attention of the "Alanthus," which gave an alarm and, finally, through the efforts of the crews of this vessel and the American liner, "General George Goethals," food, water and fresh air were passed to the crew and a sufficiently large hole was cut to release them.

The disaster was due to the failure to close the outboard air valve from the control room. In future this valve will be closed *before* the order is given to dive. The valve being open, as soon as the vessel submerged the water found its way in through the induction valves in the various compartments. Fortunately the motor room valve was tightly closed, but the valve in the engine room was not fully closed down and leakage occurred here. The valve in the torpedo room was open, or only partially closed, and the quick flooding of that compartment occurred. The inquiry which will be held will determine definitely whether there was panic in the torpedo room and a failure to realize that the valve had not been driven home, and whether a proper effort was made to close it before the men escaped through the bulkhead.

Timing the Hundred-Mile-Per-Hour Racer

(*Continued from page 299*)

minutes, three and eight one-hundredths seconds, for an average speed of 99.65 miles per hour. At the start of the qualifying trial he crossed the wire at a time recorded by the clock as 6 hours, 50 minutes, 18 seconds, and 23-hundredths seconds. When he completed the first lap the timing instrument registered 6 hours, 51 minutes, 50 seconds and 6-hundredths seconds. Subtraction of the first time from the second gave 1 minute, 31 and 83-hundredths seconds—the exact time of the lap. This operation was repeated for each lap, the fastest lap being negotiated in 1 minute, 30 and 8-hundredths seconds.

The tape, shown in one of the accompanying photographs, on which DePalma's four record breaking laps are recorded, shows the following figures:

	Hours	Minutes	Seconds	Hundredths
End fourth lap.	6	56	21	31
End third lap..	6	54	51	23
End second lap.	6	53	20	73
End first lap...	6	51	50	06
Start first lap...	6	50	18	23

Total time, 4 laps, 6 minutes, 3 and 8 one-hundredths seconds.

Lap time—First lap, 1:31:83. Second lap — 1:30:67. Third lap — 1:30:50. Fourth lap—1:30:08.

The Toolmaker's Tools

(*Continued from page 302*)

the molten ferro-silicon remains at the bottom. When the furnace is full it is pulled out of the way, the alumina allowed to solidify and the sides taken off. The pig as it is called is then removed and allowed to cool. Several of the companies tap the molten corundum and operate each furnace continuously although the majority use the intermittent type.

The pig, now fused and crystalline corundum, is broken up and sent to the finishing plant where the material is crushed, refined and made ready for wheel manufacture. Much depends upon the skill with which the furnace is operated. The size of the crystals, their freedom from impurities, etc., all play an important part in the quality of the finished product. Carborundum is another product of the electric furnace and is of interest in that it is never found in nature but is purely an artificial product. Its commercial production is due to E. G. Acheson, who in 1891 made the crystalline carbide of silicon in carrying out some experiments on the crystallization of carbon.

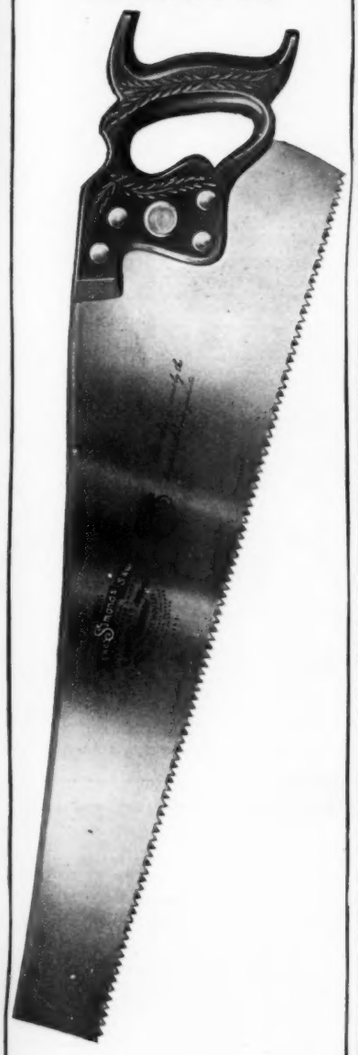
The raw materials used in the making of carborundum are quartz or silica, coke, sawdust and salt. The sawdust is added to make the charge porous and to permit the escape of the carbon monoxide formed during the reaction. The raw materials are heaped up around a central core of carbon or graphite and the heat generated in the furnace by the passage of electric current effects the conversion of the carbon and silica of the charge into carborundum or silicon carbide. The salt is added to remove the impurities in the coke and sand, such as iron, by the formation of volatile chlorides.

On dismantling a carborundum furnace after the completion of a run a great variety of products is found. The carbon core is completely converted into graphite and is surrounded by a ring of crystallized carborundum. Next to this is a layer of carborundum powder while outside this again is a ring of siloxicon or fire-sand which is a compound of silicon, carbon and oxygen. This latter is used largely as a refractory substance.

From the above it is seen that the temperature plays an important part in this reaction and it has been found that the range within which the carborundum is formed is from 1,550 to 2,200 degrees Centigrade.

Artificial corundum and carborundum, both of which are sold under a multitude of trade names, form the basis of the modern abrasive industry and are applied to uses best adapted to their characteristics. Aluminous abrasives find their greatest use in the grinding of substances like steel in their characteristics, while carborundum is used to a greater extent on cast iron and in the masonry trades.

SIMONDS
SAWS



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Both make valuable refractory substances and, in passing, carborundum brick is now being successfully used as a lining for boiler furnaces. Carborundum is also used in the elimination of gases from steel since it acts as a powerful de-oxidizer.

In the making of the actual wheel a variety of bonding materials, which serve to hold the abrasive grains together, are used. The greater portion of the wheels is made by the vitrified process. Suitable clays and fluxes are mixed in the proper proportions with the grains of abrasive. After the mixture is just right it is poured into molds and worked up and down to eliminate air bubbles. The molds rest on some absorbent material and the rough wheel soon dries partially out. It is then rough shaved and the central hole bored and is then placed in ovens where all the moisture is driven off.

The wheel is then ready for the kiln and the burning process which follows resembles that in use for porcelain ware. Saggars are used to contain the wheels. The saggars are rings of fireclay covered top and bottom with fireclay tile. Quartz sand is used inside these saggars to prevent the flame from reaching the wheels while being vitrified.

The kiln is started with a slow fire and is 72 hours attaining the maximum temperature of 2,300 degrees Fahrenheit. The kiln is then allowed to cool down gradually for a period of five days, when the charge is drawn.

The burning process is a delicate one and requires much skill. If the temperature is changed too suddenly, the wheels will crack and if they receive too much heat they will be too hard, while if too little, too soft. After being fired the wheels are trued up and are ready for market.

For silicate wheels the same abrasives are employed as for the vitrified process; a different bond is used however. Silicate of soda or waterglass is the principal bonding material used in the manufacture of these wheels. After it has been thoroughly incorporated with the abrasive in mixing machines, the whole mass has a thick adhesive nature. It is then tamped into molds, a cover put on and the whole baked in an oven at about 800 degrees Fahrenheit.

Shellac is the principal ingredient in the bond of elastic wheels. After the mixture has been prepared its consistency is such that if for thin wheels it may be rolled into shallow molds. Thicker wheels are molded under hydraulic pressure or rammed into molds the same as silicate wheels. They are then baked at a low temperature to set the shellac. By the elastic process very thin wheels may be made and used with safety. Wheels as thin as 1/32 inch are procurable and find considerable use in the cutting of high speed steel. Wire mesh is sometimes inserted in them for strength.

Solving the Labor Problem—I

(Continued from page 304)

courtesy to and consideration for the other fellow.

"This spirit is, in fact, simply an exemplification of the highest standard of real American citizenship."

The securing of a *condition of mutual confidence* between men and Management is in our opinion the only way to create such a permanent satisfactory relation as will make for real stability and permanent prosperity.

The old policy of suspicion and the attempt by each side to get what it wanted by barter and long-drawn-out and oft-times impossible agreements, or through force born of temporary strength of position, has proven a miserable failure for all concerned. The route "to a condition of mutual confidence" is a long one full of weary days and nights and of the need of much of human sympathy and understanding, of great patience, of much per-

Wire Rope—the Oil Finder

To try to catch up with the great petroleum shortage, hundreds of crews are drilling day and night, sinking narrow holes straight into the earth, seeking oil.

Some strike it at a few hundred feet. Others go thousands without even a promise. Nearly all depend upon wire rope for such success as finally may be attained.

Cables for drilling must be strong because the tools often weigh two tons, and the cable in the hole must be sustained by the upper portion. They must be elastic to give the necessary snap to the tools to drive them into earth or rock at each stroke, and to withstand the shock when the tools meet no resistance. They must also be able to withstand constant rubbing against the sides of the hole.

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Reconstructing Stonehenge

(Continued from page 308)

put in hand. Steel joists are attached to the protecting framework, four screw jacks are placed beneath them, and gently, just a fraction of an inch at a time, the stone is lowered back into its original hole. Having obtained from the earth all the evidence of origin that can possibly be found, the base is filled in with concrete thus giving the pillar a solid and sure foundation.

While this giant surgery that is being practised on the trilithons is an interesting thing to see there is something else happening at Stonehenge less spectacular, but to the archaeologists, still more exciting. One by one at an interval of about seven paces from one another a whole ring of newly discovered holes has been laid bare just inside the earthwork which surrounds Stonehenge. An old map gave the clue to their existence. It showed certain—now vanished—depressions in the turf and the excavators determined to ascertain what they meant. Equipped with a heavy steel bar with a sharp point they began their search. Once they found the first hole the others soon followed; the steel bar, instead of encountering the hard chalk, went right through; the turf was turned back and there with all the fascinating accuracy of a puzzle, was the hole just where it ought to be.

It is believed that these holes held stones—not of the size of the huge trilithons; but yet of a good size—and if that be so, then outside the two circles of Stonehenge and the two horse-shoes there was yet another ring, and this was, perhaps, there before Stonehenge as it is known today was built. There are no stones in any of these holes now. It may be that the now prone "Slaughter Stone" which lies outside Stonehenge proper once belonged to this newly found circle.

It appears that at some period these holes were used as burial or cremation places, for there have been found in each of them a quantity of burnt human bones. Many years ago bones of animals were dug up round the Altar Stone, and among the ruins numerous stone implements have been found. Of metals nothing has been unearthed except a small piece of copper.

The discovery of these stone implements and the entire absence of iron and other metals have led many scholars to conclude that Stonehenge was reared when early man in Briton still used tools of stone and when metals were barely known. That takes us back to sixteen or eighteen centuries before the birth of Christ, making Stonehenge somewhere between 3,500 and 4,000 years of age.

At present there is certainly no definite evidence as to its age or for what purpose the early Briton reared this wonderful pile. Some have ascribed it to the Druids, but when they appeared in Briton not only copper, but bronze and iron were known and used. Others have said it was a Buddhist Temple, and still others that it was a fortress, or a meaningless pile which the Romans compelled the Britons to build in order to keep them quiet.

Its origin is wrapped in mystery. We know the date of nearly all the world's great ruins, but not of Stonehenge. It is equally true to say that we have no definite knowledge either as to the use to which it was put. It was hardly reared as a monument to some mighty chief, for no honored dead was ever laid to rest beside the Altar Stone.

But the discovery of animal bones in large numbers round the Altar Stone and the unearthing of burnt human bones by the present restorers inside the earthwork would go to show that it was a temple or worshipping place of the early Britons.

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2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Editor will cast the deciding vote.

These bones were the victims of the sacrifices. With these some primeval priest conciliated his deity. But what god it was that the early Britons worshipped amid these circles of massive stones we cannot at present say.

Now that Stonehenge has become the property of the nation and is being restored under the guidance of expert engineers and archaeologists, it is certainly to be hoped that they will be able to throw some light on these much-discussed problems. Already they have been on the ground for six months, but so colossal is the task that another year and perhaps two will expire before their work is finally finished. By that time the riddle of Stonehenge may be solved. Who can tell?

To Make Hens' Eggs Hard

WE do not refer to the familiar boiling process, but to a method of making the shells thick and tough. This is a trick of the trade known by veteran poultrymen. Make up a supply of lime-water, just as though you were preparing whitewash, and strain off the liquid. Use this for several days in the poultry wet mash, at the rate of about a quart of liquid to 100 hens.

"There is nothing I know," declared a poultryman of many years' experience, "which will stop soft-shelled eggs in a flock so quickly and sensationally as this. Lime, of course, is the principal element in the egg shell, and the limewater supplies it in concentrated form. The eggs will become so hard that you can pour them from a basket just the way you pour water from a pail, and they won't break."

This is a poultry trick you can try on your friends. You can make your flock renowned all over the district for its hard-shelled eggs, and nobody will guess the simple secret.

But ordinarily, soft-shelled eggs in a flock can be corrected by other methods. Always, of course, there ought to be ample oyster shell before the flock. Then the feeding of alfalfa or clover is a great help, as these materials contain considerable lime.

It is possible, of course, to have eggs with shells too hard. At the hatching period, shells of only medium thickness are desired, as they can be broken by the chick without undue labor. The danger at other periods is more from soft-shelled eggs—not so much because they must be handled more carefully, which is the case, but because they break easily in the nest and may cause the flock to acquire the egg-eating habit, an exasperating, disagreeable thing to fight.

"Flu" Experiments on Monkeys

DEVOTEES of the theory that man is a remote descendant of the ape family will seize with avidity upon the scientific conclusions of medical authorities that monkeys, like folks, are susceptible to the attacks of influenza. Under the direction of Major F. G. Blake and Major R. L. Cecil, the Army Medical School of Washington, D. C., recently completed tests with 22 monkeys to determine the effects of influenza on the ape family.

The monkeys were inoculated with B. influenzae by swabbing the upper respiratory tract with a culture of the disease germ isolated from a case of influenzal pneumonia which had developed in a man. The virulence of the disease was subsequently raised. The period of incubation embraced from three to six hours.

The experiments indicated that influenza exercised the same influence on monkeys as on the human family with respect to its behavior, symptoms, complications and pathology. The medical directors described the action as "an acute self-limited respiratory disease identical with influenza in man." Similar results were obtained when pursuing a different method of inoculation, intra-tracheally, with the exception that one monkey evidenced no signs of infection.

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As a practical survey of the whole electrical field, proceeding gradually from elementary to advanced topics yet keeping all within the compass of an easy handful of book, this improved edition combines the features of a small encyclopedia, a text for the student, and a reference work for the advanced electrician. By ignoring obsolete machinery and methods it makes room for a surprising amount of modern theory and practice.

THE ENGINES OF THE HUMAN BODY. By Arthur Keith, M.D., LL.D., F.R.S. Philadelphia: J. B. Lippincott Company, 1920. 8vo.; 284 pp.; 2 plates, 47 figures.

The general reader will gain a fresh and arresting conception of the body from this simple account, which regards the muscles as reciprocal engines, the bones as levers, the cartilage and synovia as elements of a perfect lubricating system, the heart as a double pump, and the thorax as bellows. We are shown heat-regulating devices, transport and postal systems, workshops and laboratories; in connection with the brain, the master machine, we find cameras, telephones and a stabilizer. Thus the body is viewed from the standpoint of the mechanical engineer, and concrete, vivid impressions result in indelible memories.

PROPORTIONAL FORM. By Samuel Colman, N.A., and C. Arthur Coan, LL.B. New York and London: G. P. Putnam's Sons, 1920. 8vo.; 265 pp.; 156 illustrations.

Those who had the pleasure of seeing "Nature's Harmonic Unity" will enjoy this supplemental volume by the same authors. In it they demonstrate that order, as heaven's first law, is as conspicuously the rule in beauty as in the heavenly bodies. Why do certain forms delight us, while others repel? The work goes far toward answering this natural question by pointing out the laws of a harmony of form analogous to those of motion, music, and color, in which able aid is contributed by Mr. Colman's rich gallery of drawings, geometrical, botanical, architectural, and physiological. The architect and designer will find here basic research and suggestion, but the facts are phrased for "all students of beauty past and present."

NEW GEOGRAPHY, BOOK TWO. By Wallace W. Atwood, B.S., Ph.D. New York: Ginn and Company. 4to.; 304 pp.; maps and illustrations.

The second book of the Frye-Atwood two-book course in geography adopts, for the first time in an American text, the regional treatment used by the best European schools. This divides the world into regions according to life-conditions, and organizes work around the problem method, in which the class studies with the book open before it and is led by judicious questioning to make educative generalizations. The text stresses city geography—in which section nine airplane drawings are a feature—and correlates geography with history. The book's graphic and dramatic qualities engage the undistracted attention of the grammar-school pupil.

APPLIED AERODYNAMICS. By Leonard Bairstow, F.R.S., C.B.E. New York: Longmans, Green and Company, 1920. 8vo.; 565 pp.; illustrated.

"Applied Aerodynamics" is a work of substance and distinction. As adviser to the British Air Ministry the author had access to authoritative sources, and findings from the unpublished reports of the Advisory Committee, covering the period of the war, are generously besprinkled throughout the work. The new knowledge is utilized in a careful exposition of the principles of flight and their practical application. The book includes a description of the different classes of aircraft and develops the laws of stable flight on elementary principles. Then come details of to-day's practice, with analyses of performance. Experimental modes of obtaining basic facts from actual flight and from models and parts in wind channels are thoroughly canvassed. The photographic studies of flows and eddies are worthy of special mention.

ZOÖLOGY. By T. D. A. Cockerell. Yonkers-on-Hudson, New York: World Book Company, 1920. 8vo.; 580 pp.; illustrated.

A new volume of the "New-World Science Series" is this text-book for colleges and universities by a professor of zoölogy in the University of Colorado. Prof. Cockerell strives to present his information in such manner that a residue of vital importance will be left in the student mind. Details of structure and classification are not carried to a bewildering complexity, and numerous biographical chapters introduce the element of human interest. The New York Zoölogical Gardens contribute many of the excellent photographs, and the drawings were made expressly for this work. Among other subjects handled with a sure touch are the origin and migrations of fauna, genetics, and entomology.

CUBA, PAST AND PRESENT. By A. Hyatt Verrill. New York: Dodd, Mead and Company, 1920. 8vo.; 240 pp.; illustrated.

An inviting volume is this, with enough pre-intervention history to justify its title; for the rest, we find broad sketches of Cuba's physical, climatic and industrial features, intimate glimpses of Havana and Santiago, life and customs, and notes on travel. There is a good folding map, and the new edition incorporates 1919 facts and figures.

TELEPHONIC TRANSMISSION. By J. G. Hill. New York: Longmans, Green and Company, 1920. 8vo.; 400 pp.; 196 diagrams.

Designed as a bridge between mathematical theory and its application to the problems of the telephone engineer, this British work helps him to efficient and economical solutions. The reader will find a great many fully-worked-out examples involving the use of transmission formulæ, and a chapter on transmission measurements; simple proofs of transmission equations are furnished, in addition to the usual proofs requiring a high degree of mathematical knowledge. Practical applications of laws are given generous space, and important cost problems and standard cable practice are carefully set forth.

PROSPECTOR'S FIELD-BOOK AND GUIDE. By H. S. Osborn. Revised by M. W. von Bernewitz. New York: Henry Carey Baird and Company, 1920. 12mo.; 400 pp.; 57 illustrations.

Osborn's original work was of great assistance to prospectors; in the present edition a technologist of acknowledged ability has embodied the new knowledge of the past five years; the need of technical training is emphasized, and the student is taught how to search and how to test. Precious and base metals, and the non-metallic minerals, are given separate chapters; the value of the blowpipe is demonstrated; and oil is dealt with at great length.

CHIMICA ORGANICA. Part I. By Dott. Ettore Molinari. Milan, Italy: Ulrico Hoepli, 1920. 8vo.; 624 pp.; 254 illustrations.

This valuable and substantial work appears in a third edition, revised and amplified. Statistical data accumulated since 1913 are added to the original contents. The first section of the volume deals with analyses, determinations and properties in a general way, and concludes with the classification of organic substances and the official nomenclature. The second section deals specifically with the applications and processes involved in the industrial utilization of important substances such as petroleum, alcohol, acids and their derivatives.

GEOLOGY OF THE MID CONTINENT OIL-FIELDS. By T. O. Bosworth, D.Sc., M.A., F.R.G.S. New York: The Macmillan Company, 1920. 8vo.; 314 pp.; illustrated; folding map.

Kansas, Oklahoma and North Texas embrace the world's greatest developed oil region, and give the world one-third of its production. Dr. Bosworth has drawn freely upon our Government and State bulletins and other available sources of knowledge; he gives the history of the region's development, detailed statistics of production, the general geological structure of the territory, and localized structures, presenting tables and analyses and providing much information as to processes. It is a compendium that, from the geologist's point of view, is of decided value.

THE WESTINGHOUSE E-T AIR BRAKE INSTRUCTION POCKET BOOK. By W. W. Wood. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 258 pp.; illustrated.

Patient, capable instruction marks this revised edition of a well-known pocket book, and the man who demands full knowledge in contradistinction to a limited grasp of material details will find satisfaction in the work. Particularly noticeable are the self-explanatory illustrations, in which each zone of air pressure is given its own distinguishing color. Examination questions and answers cover the No. 5 and No. 6 equipment, their operation and approved procedure in case of breaks.

Pulling Power of PIERCE-ARROW 2-ton, 3½-ton, 5-ton Dual Valve Trucks

Dual Valves produce much greater power, surprising economy of operation and surpassing performance.

Increased valve area facilitates intake and exhaust of gas. Double ignition assures complete combustion—delivering ***the full explosive power, saving gasoline*** and increasing efficiency.

Other advantages produced, without sacrifice of durability, long life or continuous operation, include accessibility to quick repairs and easy operation—both saving time and reducing labor costs.

Pierce Arrow

48 of the FIRST FIFTY trucks still running after 9 years' service.

Delivers more work in a given time.

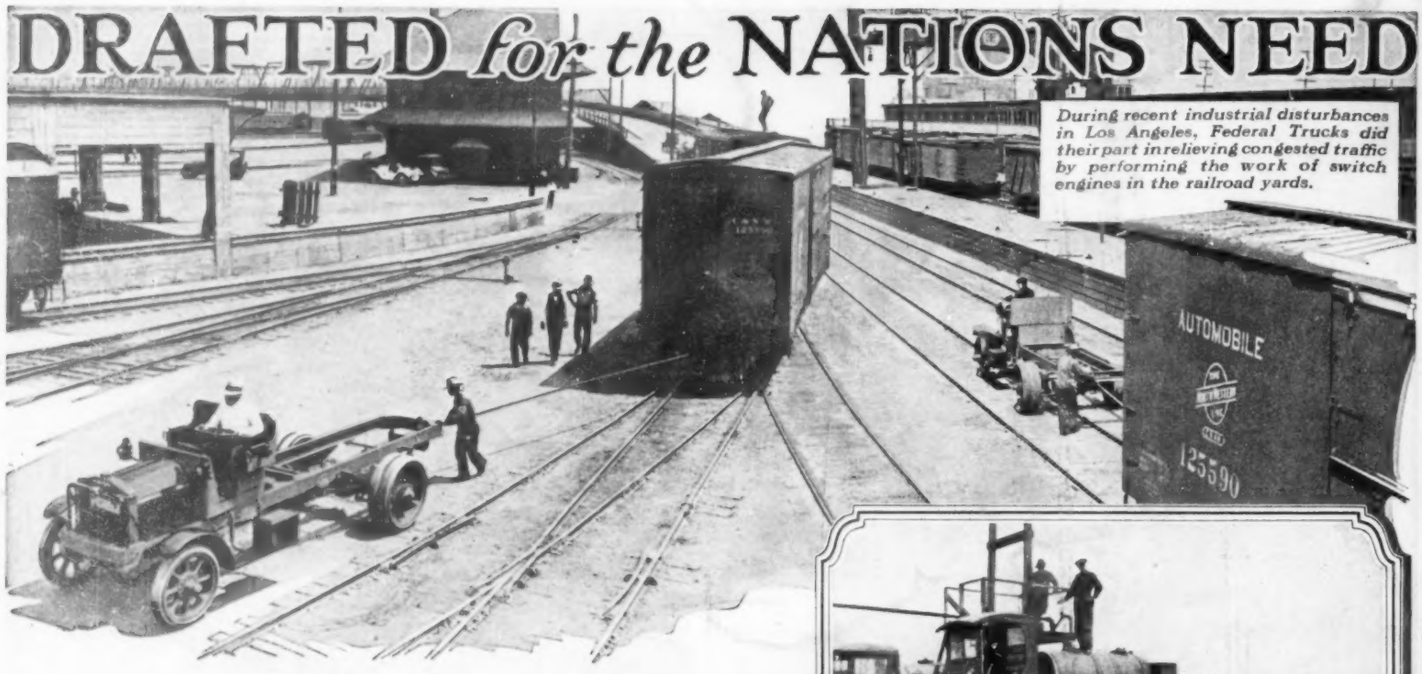
Loses less time on the job and off the job.

Costs less to operate and less to maintain.

Lasts longer, depreciates less, commands a higher resale price.

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N.Y.

DRAFTED *for the* NATIONS NEED



During recent industrial disturbances in Los Angeles, Federal Trucks did their part in relieving congested traffic by performing the work of switch engines in the railroad yards.

AMERICA has again called her motor trucks into service. An emergency, no less important than her war time needs, has demanded the limit of their power and resources.

Congested traffic, crowded terminals, warehouses heaped high with goods awaiting shipment, unmoved freight, unloaded cars—all tell their own story of industrial unrest and the woeful inadequacy of our present transportation facilities.

In its hour of need the nation has found but one solution to its transportation tangle—the complete and hearty co-operation of its railroads and trucks.

Nothing can match the speed and certainty of the motor truck as a short haul carrier.

Nothing can match the economy and dependability of the railroads in speeding long haul shipments.

Working together—our trucks and our railroads—both doing their part—the freight *can* be moved.

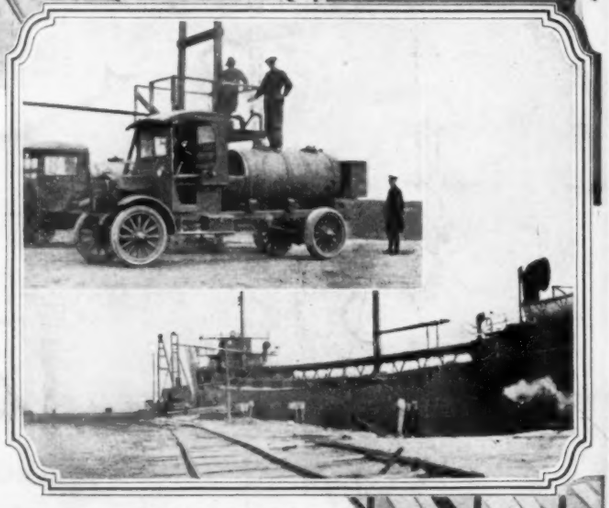
What is *your* part? Conscript *your* trucks into the service of the nation.

Use them wherever possible on the shorter hauls. Move the goods promptly from warehouses, terminals, factories and farms.

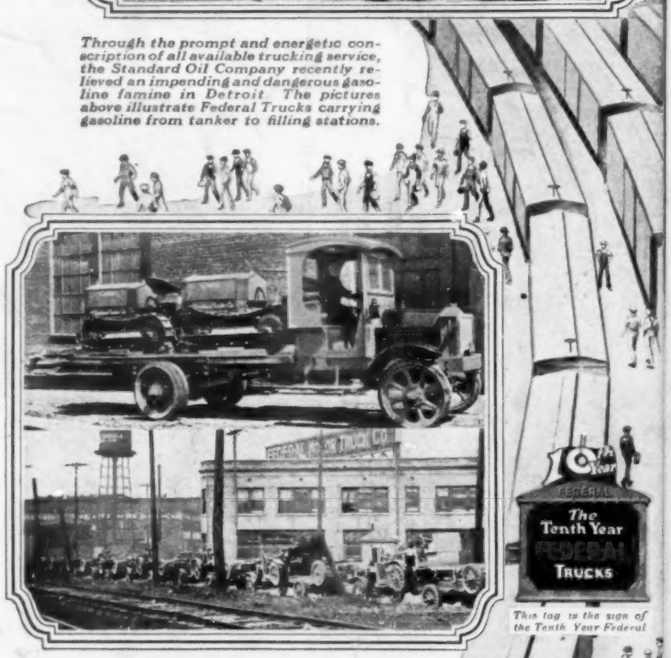
Conserve the valuable resources of our railways by utilizing, to the very limit, the resources of all motor trucks.

And the goods and our crops will move.

FEDERAL MOTOR TRUCK COMPANY, DETROIT, MICH.

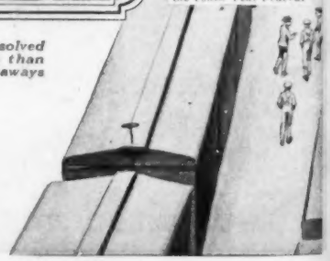


Through the prompt and energetic conscription of all available trucking service, the Standard Oil Company recently relieved an impending and dangerous gasoline famine in Detroit. The pictures above illustrate Federal Trucks carrying gasoline from tanker to filling stations.



This tag is the sign of the Tenth Year Federal

Motor cars and trucks have, to a large extent, solved their own transportation problems. More than 78,000 automobiles and trucks were driveaways during the month of May.



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